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The Newer Concepts of Meat in Nutrition

Meat . . .

and its Role in Maintaining the Productivity of the Older Worker

With the increase in manpower shortage resulting from war-induced industrial expansion and the demands of the armed forces, many elderly and retired persons—men and women alike—are being recalled to former jobs and to newly created positions. In most instances, this rehabilitation imposes a sharp increase in energy expenditure, a change from sedentary living to one of considerable activity.

In order to enhance and maintain the productive capacity of these workers, eating habits may have to be profoundly altered. The dietary usually chosen by elderly persons not gainfully employed proves inadequate for sustaining the proper nutritional state during periods of constant and prolonged physical exertion.

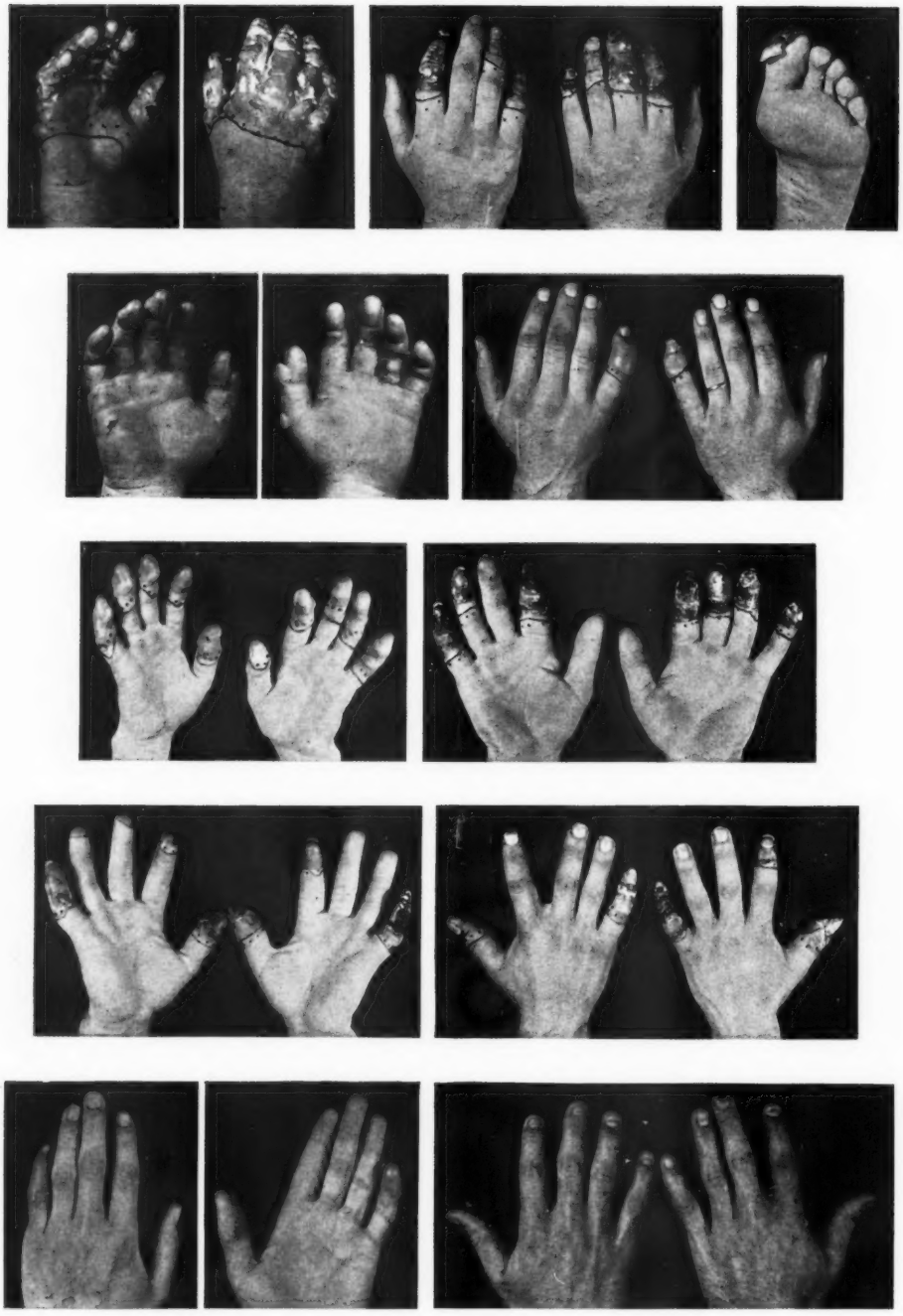
In the formulation of these dietaries, meat proves of high value in bringing the intake of essential nutrients to competent levels. Its biologically complete proteins furnish the essential amino acids lacking in proteins of many non-rationed foods, thus making the total protein intake nutritionally adequate. Its extractives play a significant role in appetite stimulation and improvement of digestion, an important function in persons suddenly called upon to increase their caloric intake.

The vitamins provided by meat—thiamine, riboflavin, and niacin—aid measurably in satisfying the increased requirements for these nutrients during periods of augmented energy expenditure. Meat also contributes generously of iron, copper, and phosphorus, so necessary in maintaining physical stamina and endurance.

On the basis of its many nutritional advantages, meat is much more than merely an excellent source of protein. Eaten in the full amounts now permitted by the rationing program, it presents a real aid in making the dietary nutritionally adequate.

The Seal of Acceptance denotes that the nutritional statements made in this advertisement are acceptable to the Council on Foods and Nutrition of the American Medical Association.

American Meat Institute
CHICAGO



Various Types and Stages of High Altitude Frostbite.—
Loyal Davis, John E. Scarff, Neil Rogers, Meredith Dickinson

UNIV. OF MICH.

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HIGH ALTITUDE FROSTBITE

Preliminary Report

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COLD damage to the extremities suffered by the high altitude airman is unique among injuries of thermal origin. It differs from the common frostbite as greatly as the "Bird's Eye" frozen foods differ from cold storage foods. One fundamental fact is common to these injuries, to the frostbite incurred by ground troops during severe winter weather, and the immersion foot of shipwrecked seamen; namely, that the primary agent which produces the pathologic changes in the affected tissues is *cold*.

The secondary mechanisms, however, which operate to make the tissues particularly vulnerable to cold differ between common frostbite, immersion foot, and the frostbite of the high altitude flyer; and in the latter case are, in many respects, unique.

In high altitude frostbite, for example, extreme degrees of cold (—40 to —52° C.) are encountered. The effect of these low temperatures upon the tissues of the extremities is further augmented by varying degrees of anoxemia and ischemia. In the frostbite incurred by ground troops the flat surfaces of the face and of other exposed portions of the body, as well as the extremities may be attacked; whereas, in high altitude frostbite one of the most striking features is the predilection for the extremities. In immersion foot, the degree of cold is moderate in comparison and the secondary factors are venous stasis, maceration of the skin by sea water, infection of the soft parts introduced through the macerated skin, malnutrition, and lowered general vitality due to sheer physical exhaustion. In the frostbite of the high altitude flyer the exposure to cold may last only a few minutes, whereas in the frostbite of ground troops or the immersion foot of the seaman, the exposure to cold may be for days or even weeks.

CLINICAL TYPES

Mild type. It is quite common to find that an airman removes his gloves in order to make some necessary adjustment of his equipment. This may require only a minute or two. However, during this brief time the fingers become painfully cold, numb, stiff, waxy white in appearance, and completely insensi-

tive to touch. They feel hard and even brittle when palpated and if the fingers are struck against a hard object, the sound produced is similar to that which would follow if a piece of wood were struck against the same object. The fingers cannot be flexed or extended voluntarily and often are so stiff that they cannot be moved with the other hand.

Recovery from this condition may be quite slow, even after removal to a warmer environment, and quite often hours elapse before the tips of the fingers begin to soften. Even after the tissues become less hard and approach normal, the waxy or ashen white ischemic appearance may persist for several more hours (Fig. 1). The surface temperatures, as recorded by thermocouples attached to the finger tips, may be 4 to 6 degrees (C.) colder than the corresponding fingers of the unaffected hand. Capillary microscopy of the affected fingers at this early stage shows no blood whatever in the terminal capillaries on the dorsum of the fingers about the nail beds (Fig. 2). This would appear to be the result of an initial intense vasomotor spasm of the terminal portions of the arterioles and, in some instances, to a secondary thrombus at the point where the arteriole, with its muscular wall, passes into the thin-walled capillary. These findings will be presented in detail in the discussion of the pathology to follow.

If at this stage, the individual's extremities and body can be brought back to the normal body temperature, no permanent ill effects may result. His fingers, however, may ache and throb for several hours and paresthesia may persist for days or weeks but there will be no blistering, gangrene, or other gross anatomical residuals.

Severe types. If the exposure to cold is prolonged, permanent damage to the tissues of the extremities will occur and definite clinical manifestations of severe damage become apparent. These sequelae follow two patterns which for convenience may be described as the "wet" and the "dry" forms. The fundamental pathology of the two types is essentially the same.

In the *wet* type, multiple small cutaneous blisters appear rather simultaneously upon many points of the skin of the affected part which rapidly grow in size and coalesce to form one or several huge blisters involving the dorsum of a finger, or even the dorsum of the entire hand. These may be similar to the simple vesicles incurred in second degree burns, and contain free fluid, but more often the blisters differ from the blisters of burns in that the pathologically excessive fluid is held fast within the tissue composing the superficial layers of the skin. The blisters may have the appearance of simple vesicles containing free fluid, but if an attempt be made with a syringe and needle to aspirate the fluid, none, or only a very small amount, can be obtained (Fig. 3a). However, fluid will slowly ooze from the needle puncture holes for many hours. This fluid may be a clear transudate (Fig. 4a) or it may contain blood corpuscles (Figs. 5a, b). The latter rapidly turn a dark color and impart to the affected parts an appearance easily mistaken by the uninitiated for gangrene (Fig. 15a). This dropsical condition tends to persist for 2 or 3 days after which the fluid disappears and the superficial layers of the skin become loose and wrinkled, then dry and hard.

Hemorrhage usually takes place beneath the nails giving them the same appearance as a nail which has been crushed and, in such cases, the nail is lost.

In both the simple vesicles and in the dropsical blisters, the superficial layers of the skin are dissected away from the deeper layers by extravasated fluid. When this skin dries and hardens it is cast off, frequently in the form of a complete cast of the part (Fig. 7). The separation occurs just beneath the basal germinal layer of the epithelium so that the greater part of the germinal layer comes away with the cast (Fig. 8). Epithelial regeneration later on is possible, therefore, only from the remnants of the germinal epithelium remaining in ducts of the sweat glands in the same manner as re-epithelization occurs at the site from which split thickness skin grafts have been taken.

The newly regenerated skin is thin, tightly drawn, smooth, shiny, and varies in color from a dusky pink to a dusky blue (Fig. 3b). The exact color fluctuates freely from one extreme to the other with changes in the

temperature of the environment. The part is extremely sensitive to cold. On cool mornings the fingers have a dusky blue color, feel cold, and are painful. As the environment and the patient's own body warm up, the fingers tend to become pink in color, warm, and free from pain. This reflex warming, however, is never as great as in the normal hand. Cold tolerance is strikingly reduced. Whereas the normal hand placed in an environment minus 20 degrees centigrade will resist freezing for over an hour, the hand which has been frostbitten, placed in the same environment will freeze within 10 to 20 minutes (Fig. 9).

After periods of time varying in individual cases according to the severity of the injury, the skin gradually resumes a normal appearance, normal subjective and objective reactions to environmental cold, and the capillary loops slowly regenerate. However, this requires months and, in some of the cases studied, complete anatomical and physiological recovery of the skin to normal has not occurred after 8 or even 10 months.

Anesthesia or hypesthesia to pain and touch is always present to some degree in the affected extremities and commonly extends well proximal and beyond the areas of apparent damage to the skin itself (Fig. 10). These changes may persist for months (Fig. 4b).

Fig. 1. Photograph of hand 7 hours after exposure to temperature of −40 degrees centigrade showing persistent blanching of the fingers due to vasoconstriction.

Loss of sweating usually occurs in the same areas as the impaired sensation and lasts as long as the sensory loss continues (Fig. 4b).

The *dry* type of high altitude frostbite is usually associated with a more severe exposure to cold. In its initial stage it is indistinguishable from the wet type. The extremities may be literally as hard as rock and require longer to thaw out. At about the time that blisters would appear in the wet type, none develop in the dry type. Instead, the affected parts become very tense, the skin assumes a dull ground glass appearance

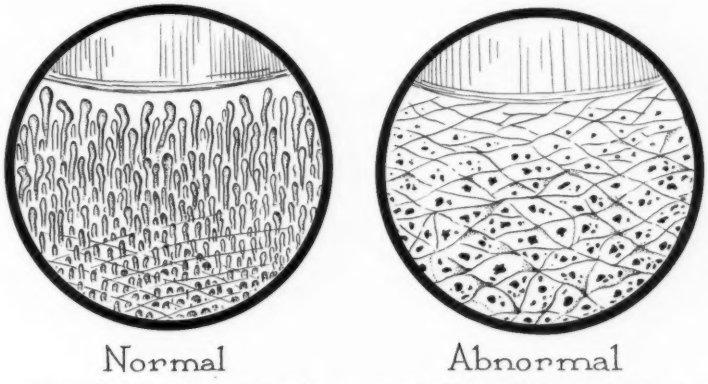
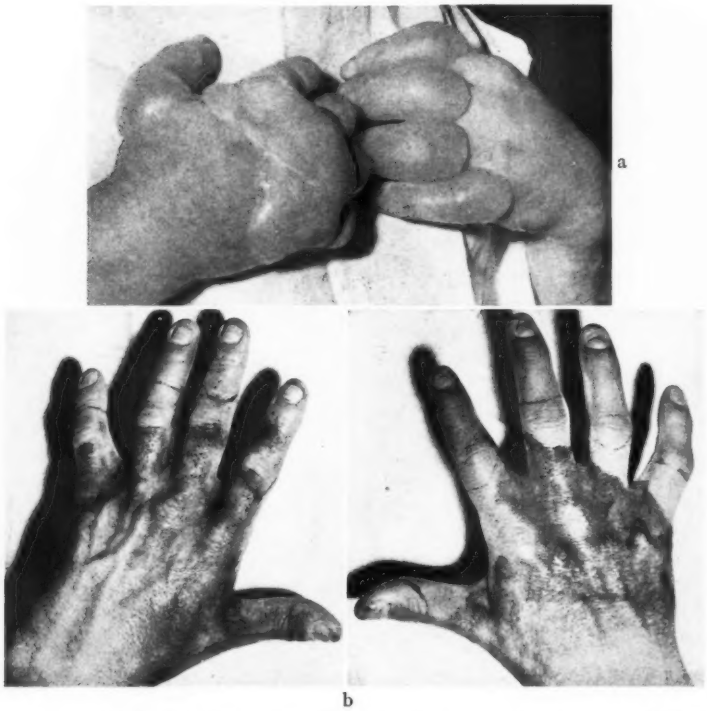


Fig. 2. Drawing of the microscopic appearance of the capillary bed at the base of the nail in normal finger and in frostbitten finger. Note the hairpin appearance of the normal parallel capillary loops which are absent in the affected finger. The thrombosed stumps of the arterioles are characteristic of the frostbitten finger.

a b

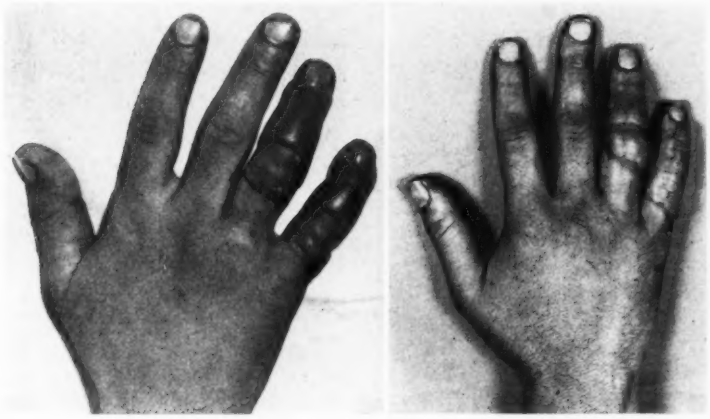
Fig. 3. a, Typical blister formation in a moderately severe frostbite. The index finger shows a simple vesicle which has completely collapsed following incision. The middle finger shows a blister which has failed to collapse following a liberal incision due to the fact that the excess fluid is held within the tissues. Both blisters are non-hemorrhagic. b, The same fingers 1 month later after the blisters had dried and desquamation had taken place. Note loss of nail and the absence of normal skin markings and the delicate, tight, shiny, new epithelium. These fingers remained sensitive to cold for many months.



a

b

Fig. 4. a, Photograph shows severe example of blistering in the wet type of high altitude frostbite 24 hours after injury; b, same hands 2 months later showing regeneration of lost nails. The skin in the blistered areas is beginning to recover its normal surface markings. Sensory disturbances and loss of sweating persisted for many months.



a b

Fig. 5. a, Hemorrhagic blisters in a moderately severe frostbite. Note discoloration of the nails. b, Same hand 10 days later. The blisters have dried up and the skin has an ecchymotic appearance. Desquamation occurred later.

Fig. 6. Photograph showing example of severe hemorrhagic blistering in the wet type of high altitude frostbite 24 hours after injury.

(Fig. 11a) and the deeper tissues take on a dusky gray color which gradually becomes darker and darker. As time goes on the skin becomes quite dry and the deeper tissues become darker and darker (Fig. 12a, b, c). All the tissues shrivel and mummify and eventually become completely hard and coal black (Fig. 13a, b). These changes are always more marked at the distal end of an extremity; the proximal phalanx is never involved unless the more distal ones are affected. Demarcation between the black, dry, mummified distal portion of the finger and the vital tissue becomes sharp, usually after 2 or 3 weeks. Spontaneous natural amputation will take place if time is allowed, but this process is usually hastened by surgical intervention (Figs. 14a, b; 15a, b; 16a, b; 17a, b, c).

PATHOLOGY

From a pathological viewpoint, the most striking feature of high altitude frostbite is the

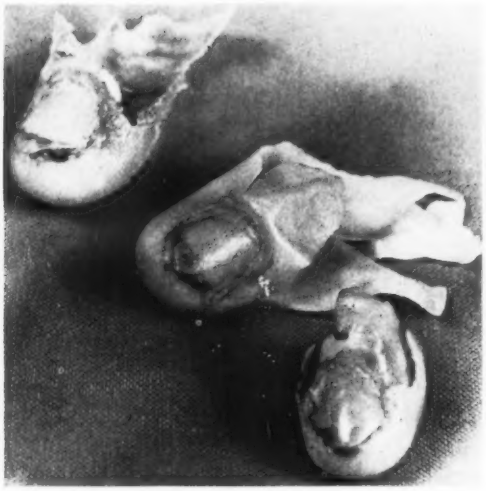


Fig. 7. Cast-desquamation of the tips of the fingers which followed severe blistering in a case of the wet type of high altitude frostbite.

fact that whereas the face may be exposed to severe cold for several hours without apparent damage, exposure of the fingers to the same degree of cold for only a few minutes may produce damage to tissue so great that gangrene and loss of fingers will result. It must be assumed that the inherent tolerance for cold in a warm blooded animal having a relatively constant body temperature is essentially the same for all tissue cells. It is difficult to explain the great difference in cold tolerance between the tissues of the cheek and the fingers upon the basis of the greater heat radiating surface of the fingers. The heat radiating surface per tissue mass in the fingers is three to four times greater than in the cheek but the susceptibility to cold is fifty to one hundred times greater. Therefore, contributing mechanisms secondary to the primary action of cold on tissue cells must be sought for.

Generalized anoxemia, when it occurs, undoubtedly plays a major rôle in the production or augmentation of tissue damage due to cold in high altitude frostbite, but its effects cannot possibly be selective for tissues in one part of the body.

Localized anoxemia resulting from the ischemia produced by intense reflex vaso-

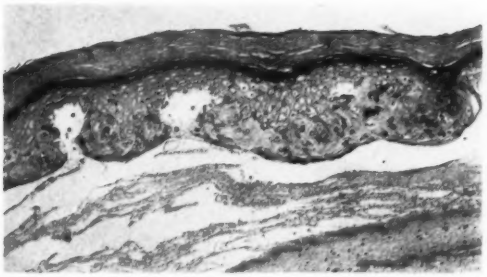


Fig. 8. Photomicrograph of section of skin from a blister in the wet type of high altitude frostbite of moderate severity. Note the separation of the epidermis from the dermis and particularly that the basal germinal layer is lost with the epidermis.

spasm of peripheral arterioles is undoubtedly the most important factor in establishing the peculiarly selective effect of cold upon the digits of both upper and lower extremities.

Acute peripheral vasoconstriction of the vessels in the extremities occurs almost simultaneously with the exposure to cold. It takes place principally at the terminal end of the arterioles. Direct microscopic examination of the terminal capillary beds in the finger tips soon after they have been exposed to intense cold has revealed the peripheral ends of the arterioles well filled with blood but the terminal capillary loops are entirely empty (Fig. 2). The evidence thus far obtained indicates that this vasoconstriction may persist for 24 hours or longer.

The basic morphological lesion in high altitude frostbite consists of damage by cold to the endothelium of the terminal capillary loops. In mild cases this results only in a pathologic permeability of the capillary walls; but in the more serious cases a thrombus formation occurs at the arteriolar-capillary junction. Under the microscope these thrombi in the terminal stumps of the arterioles are plainly visible (Fig. 2). No thrombosed capillaries have been seen, presumably because early in the train of events they have been deprived of their blood by the intense vasoconstriction which takes place at the terminal ends of the arterioles.

If the vasoconstriction of the arterioles is relaxed before the thrombosis takes place, and the capillary bed is flooded with blood, extrav-

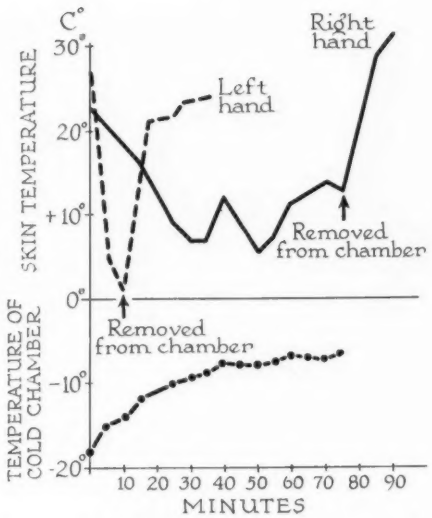


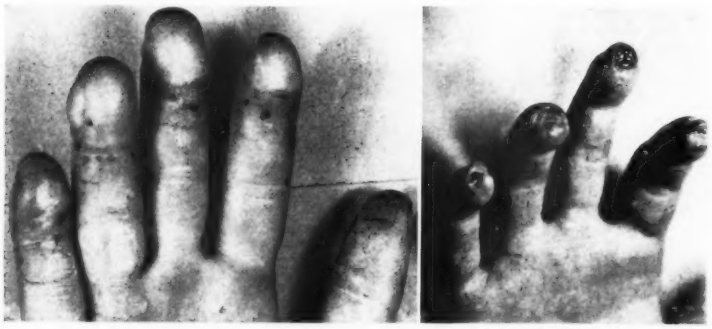
Fig. 9. Chart showing cold tolerance of normal and frostbitten hands. The lower curve represents the temperature of the experimental cold chamber (Greene). The solid line represents the temperature of the normal right hand and the broken line the temperature of the frostbitten left hand. The curves in each instance are the mean of the skin temperatures taken from the four fingers by electrothermocouples. Note that the normal hand could not be reduced in temperature below plus 5 degrees centigrade after 50 minutes in the cold chamber. At that point it spontaneously began to warm up and in 25 minutes the skin temperature rose 4 degrees centigrade. After removal from the cold chamber the hand quickly reached a temperature 8 degrees higher than in the beginning. In contrast, 10 minutes after introduction of the frostbitten left hand into the cold chamber, the skin temperature of this hand fell to almost zero and the hand became so painful that the patient's condition forced removal of the hand from the cold chamber. After removal from the cold chamber the skin temperature did not return to the original temperature.

Fig. 10. Photograph of hand 7 hours after exposure to temperature of −40 degrees centigrade. Solid lines represent limits of hypesthesia; dotted line, limits of hypalgesia. In the index and little fingers there was a complete loss of pain and touch over the distal phalanges.

asation of plasma or whole blood may occur through the damaged capillary walls into the tissues. This extravasated fluid may be held within the skin which then assumes a dropsical appearance, or it may collect as free fluid in vesicles. Eventually, the transudate accumulates in the tissue plane between the epidermis and the dermis immediately beneath, or deeper to, the basal germinal layer of cells of the epidermis. The germinal layer and the terminal capillary loops are dissected away from the underlying tissues. Small, irregular capillary loops begin to grow out of the stumps of the thrombosed arterioles after 3 to 4 months but 6 to 10 months may elapse before the appearance of the capillary bed approaches the normal. If a secure thrombosis has developed within the vessels at the arteriolar-capillary junctions before the release of the vasospasm, then the extravasation and blistering do not follow.

If the damage extends more deeply to affect the capillaries beneath the deeper fascia planes which supply muscles and bone, extravasation and hemorrhage occur in these tissues, causing increased tension and severe pain. When thrombosis occurs in the arterioles supplying these deeper tissues, dry gangrene follows. In such cases superficial blistering of the skin may not occur since the blood supply to the skin has been interrupted in the deeper tissues. The clinical picture simply progresses directly from injury by cold to dry gangrene.

The arteries show interesting changes. In 3 cases, requiring amputation of the little finger 3 months after injury from cold, the smaller arteries and arterioles showed a remarkable thickening of the intima which was eight to ten times the normal (Fig. 18). The vessels resembled those seen in cases of endarteritis obliterans. The endothelial lining of the vessels was everywhere intact; no thrombi were seen and nowhere was there a suggestion of recanalization of an earlier thrombus. The



a b

Fig. 11. a, Photograph of an early stage of a mild case of the dry type of high altitude frostbite. There is no blistering but note the ground glass appearance of the skin of the finger tips. The deeper underlying tissues were under great tension and were quite painful. Gangrene of the affected parts followed. b, Same hand 5 months later showing the loss of nails and tissue of the finger tips.

mechanisms producing these changes are not clear. However, such changes are said to follow long repeated vasomotor overactivity. The veins were not involved in these pathological changes.

Neural injuries are suggested clinically by the sensory changes in the skin and by the topographical and chronological relationships existing between sensory loss and loss of sweating. Histological studies of nerves have not been successfully made because of the difficulty in obtaining suitable tissue. Whether the loss of sweating is due to local damage to sympathetic nerve fibers or to direct injury to the sweat glands themselves has not as yet been definitely established.

TREATMENT

The treatment of high altitude frostbite must be directed in the first instance to the prevention of these injuries by reducing the necessary exposure to cold and the risks of general anoxemia. These factors are always subject to dislocation in the heat of battle

a b c

Fig. 12. a, Photograph of an early stage of a severe case of the dry type of high altitude frostbite 1 hour after injury. b, Photograph of the same hand taken 3 days later showing almost total absence of blistering. c, The same hand photographed 3 weeks later showing far advanced dry gangrene.

a b

Fig. 13. a, Photograph of a severe case of the dry type of high altitude frostbite 10 hours after injury (sulfanilamide powder dressing). b, Same hand 5 weeks later showing spontaneous amputation by dry gangrene.

and their reduction falls within the province of the tactician and the engineer.

Localized anoxemia of the extremities due to reflex vasospasm is, however, a straightforward medical problem. Its prevention and treatment present a challenge to the physician.

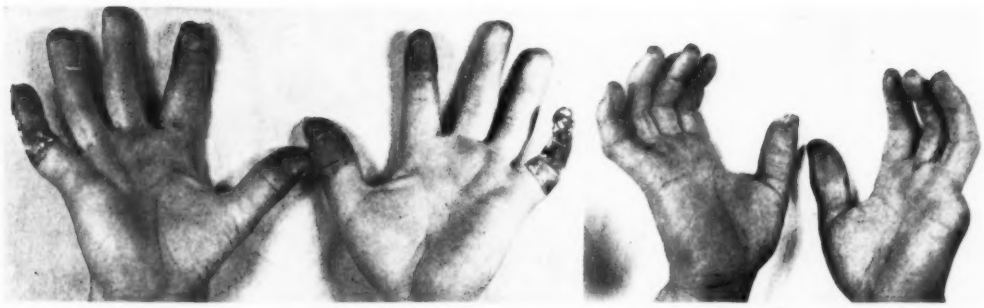
Three types of protective ointments have been studied upon the extremities of normal individuals and patients in whom cold damage has occurred from the viewpoint of preventing the lowering of skin temperature. Careful studies of skin temperature readings after controlled exposures to cold have not yielded results which would indicate that such a line of investigation would prove profitable.

Release of vasoconstriction and its attendant ischemia appear to be a matter of prime importance in the treatment of these cases and must be obtained early if the measure is to be effective; that is, before thrombosis has taken place. Vasodilatation may be brought about in the extremities in several ways.

The simplest way to produce vasodilatation is by the local application of heat, but the de-

a b

Fig. 14. a, Photograph of a severe case of the dry type of high altitude frostbite 10 days after injury. Note the early stages of mummification and dry gangrene. b, One month later after guillotine amputation of gangrenous parts.



a b

Fig. 15. a, Photograph of a severe case of the dry type of high altitude frostbite 10 days after injury showing absence of blistering and the developing dry gangrene in the little finger of the left hand. The thumb and index fingers of the right hand show the late stage of hemorrhagic blisters in which the skin only has turned hard and black. To the uninitiated this appearance is easily mistaken for gangrene. b, Same hands 5 months later.

gree of warmth which should be applied to a frostbitten extremity during the early hours or days of treatment is a moot question. Greene (1) has recommended that the frostbitten extremity be kept at a temperature approximately plus 2 to plus 5 degrees centigrade, because in his opinion (1) heat to the frozen part increases its metabolism and its oxygen requirements and encourages the growth of bacteria and (2) because warmth increases the flow of blood to the part, resulting in greater transudation and blistering. Greene cites Lake's work which showed that the survival rate of tissue cultures is greatest between minus 5 degrees centigrade and plus 5 degrees centigrade.

In line with this reasoning Greene has devised a therapeutic refrigerator (2). It contains one compartment in which solid carbon dioxide is placed and a second compartment into which the frostbitten extremities may be placed. The former communicates with the latter through vents which can be opened and closed as desired to regulate the temperature which is recorded by a thermometer and can be read from outside the box. It is possible to reduce the temperature in the compartment in which the extremities are placed as low as minus 20 degrees centigrade. He advises treatment of frostbitten extemities by placing them in the cabinet with the temperature of the air in the compartment set at plus 2 or 3 degrees centigrade and keeping them there for several days, or even a week, until their removal from the cold cabinet to room temperature is no longer followed by pain in the parts.

We have found Greene's refrigerator an ingenious apparatus and very useful for establishing controlled conditions for studying the effect of cold upon normal and frostbitten extremities. We are not yet prepared, however, to accept without reservation his ideas regarding the therapeutic value of cold in the treatment of the cold damage incurred by high altitude flyers.

It does not necessarily hold that, because temperatures between minus 5 and plus 5 degrees centigrade are optimum for tissue cultures *in vitro*, bathed with nutrient fluid, the same temperatures are optimum for the metabolism of adult tissue cells *in vivo* and dependent for their vitality upon the exchange of gases in the circulating blood. Sir Thomas Lewis (3) states categorically, "If the skin is sufficiently cold, 10 degrees centigrade (50 degrees F.) or less, the blood will not part with its oxygen." If we assume Lewis to be correct, it seems illogical to reduce the temperature of the already damaged tissues below 10 degrees centigrade to the levels of 2 to 5 degrees centigrade recommended by Greene. The point stressed by him that the metabolic requirements of the tissues are lowered at the temperature he recommends seems of little consequence in comparison with the fundamental fact that no oxygen is released by the blood to the tissues at these temperatures.

a b

Fig. 16. Photograph of a case which showed mixed features of both wet and dry types of mild high altitude frostbite. a, Hemorrhagic blistering soon after injury. b, Same hand 3 months later showing dry gangrene of deeper tissues. Note sharp line of demarcation between viable and gangrenous tissue.

a b c

Fig. 17. Photograph of a case which showed mixed features of both wet and dry types of severe high altitude frostbite. a, Huge vesicular blister 72 hours after injury. b, Same hand 10 days later showing dry gangrene developing in the deeper tissues of the finger tips. c, Same hand 5 months later.

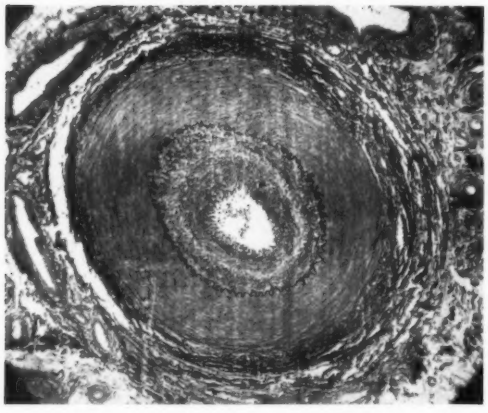


Fig. 18. Photomicrograph of cross section of a small artery 2 centimeters proximal to the line of demarcation of gangrene in an amputated finger from a severe case of high altitude frostbite of the dry type. Note the marked thickening of the intima and the absence of a central thrombus or evidences of recanalization. The endothelium is intact.

Our studies have shown that great differences in temperature usually exist between the environment and the surface of the extremity. Great variations in these differences of temperature are found between the two hands of the same individual, if one is normal and the other is damaged by cold. Also, great differences between environmental and surface temperatures may be found in the same hand with variations in the general level of the environmental temperature and the duration of exposure to that temperature. Only by taking temperature readings frequently directly from the skin itself, and preferably with an electric thermocouple, can the actual temperature of the tissues of an extremity be accurately known or even approximately judged. This is all clearly shown in Figure 9. The frostbitten left hand and the normal right hand of a patient were placed in the cold chamber the temperature of which was minus 18 degrees centigrade. The temperature of the affected left hand at the beginning of the experiment was plus 28 degrees centigrade and that of the normal right hand was plus 23 degrees centigrade. Ten minutes later, the temperature of the affected left hand had fallen to plus 1 degree centigrade and that of the normal right hand to plus 18 degrees centigrade. At this point the damaged left hand was removed from the cold box but the normal right hand was kept in the box. Forty minutes later the temperature of the right hand had fallen to plus 6 degrees centigrade, and the temperature of the cold box had risen from minus 14 degrees centigrade to minus 8 degrees centigrade.

It has been noted by many observers, including ourselves, that a frostbitten hand is more apt to blister if it is rapidly warmed or warmed above normal body temperature than if it is kept cool. Greene reasons that this is because with the warming, blood returns in large volume into capillaries whose walls have been damaged and have suffered pathological increase in permeability. Transudation takes place through these damaged walls into the adjacent tissues, thus causing the dropsical and vesicular blisters already described. With this we are in agreement. Greene also believes, however, that the most important objective in the early immediate treatment of the frostbitten hand is to prevent the formation of blisters and he would do this by restricting the quantity of blood flowing into the capillary beds by continuing peripheral vasoconstriction. This vasoconstriction he proposes to obtain by keeping the damaged parts cold; and advises keeping them in a temperature slightly above freezing from the time of injury to as long as several days. We are not prepared to accept this form of treatment at this time.

In an effort to evaluate Greene's recommendations for treatment by continued cooling, we have treated a series of cases by keeping the damaged parts at controlled temperatures approximating those advised by Greene for periods ranging from 24 to 48 hours, after the injury had been sustained. Simultaneously, we have treated a second series of cases by exposing the damaged parts to room temperature, thus allowing a spontaneous refilling of the capillary beds at a natural rate and to a normal degree without attempting to interfere with natural physiological reparative processes. In our judgment, the results obtained by this method were equal or better than those obtained by continued cooling. It is our impression that less blistering occurred in

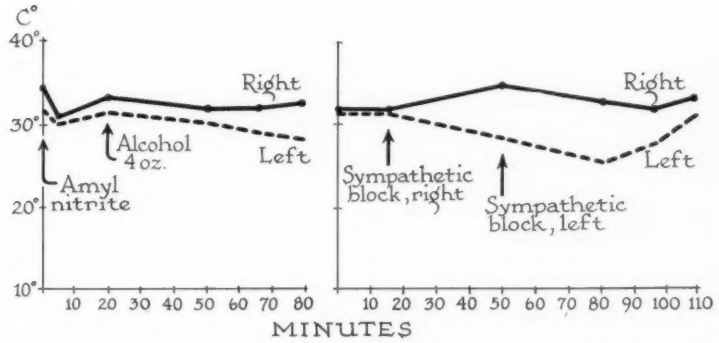


Fig. 19. Chart showing effect of amyl nitrate, alcohol and sympathetic nerve trunk block upon a case of moderately severe high altitude frostbite of both hands within an hour of injury. Thermocouples were applied to the finger tips and the capillary beds at the base of all the finger nails were examined microscopically. No blood was present in any of the capillary beds of the affected fingers. Amyl nitrate inhalation (ampuls 2) was given without filling of the capillaries. The surface temperatures of the finger tips fell sharply. Alcohol (4 ounces) was given to the patient and similar readings and observations were carried out at frequent intervals. The capillaries did not fill with blood. The surface temperatures of the finger tips of both hands dropped slightly but was more marked in the more seriously damaged left hand. Paravertebral block with 2 percent novocain was performed at the level of the first rib, produced opening and filling of the capillaries with blood, progressive rise in the skin temperature readings and appreciable warming of the right hand. On the left side, no blood was seen to enter the capillaries and there was a slight decrease in the surface temperature readings of the finger tips. The curves represent the mean surface temperature readings taken from three fingers of each hand.

those patients treated by cooling but on the other hand, the patients as a group, complained more of pain and required more sedation than those treated by exposure to room temperature and there was ultimately a greater loss of tissue.

It has been our plan whenever patients were received with two extremities equally damaged to treat one extremity with the continued application of cold and to treat the other extremity by exposure to room temperature. To date we have had only one patient considered suitable for such a controlled experiment. This patient came under treatment soon after he had received cold injury to both hands which to us appeared about equally damaged. Thermocouples were attached to the five digits of his left hand and the extremity was placed in cold packs for 48 hours. Skin surface temperature readings were made every 15 to 30 minutes during this period. The right hand was exposed to room temperature. During the 48 hours of observation the patient complained of more pain in the hand treated by cold than in the other hand. The stages in the subsequent course in the two hands was very similar. Moderate blistering

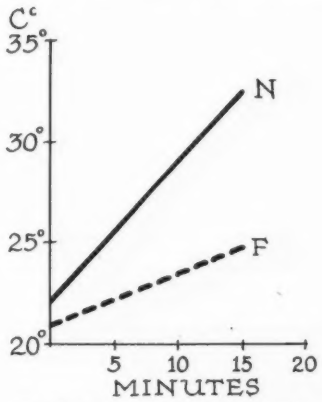


Fig. 20. Graph to show reflex warming of normal and frostbitten hands. The patient was seated in a room of average temperature, and his feet immersed in warm water at 46 degrees C. (115° F), for 15 minutes. The solid line shows the mean rise in the skin temperatures of the finger tips in a normal hand. The broken line shows the mean rise in the skin temperatures of the finger tips in a hand which had suffered moderately severe frostbite 2 months before.

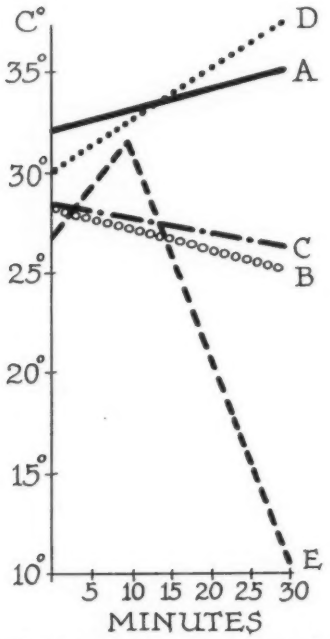


Fig. 21. Graph to show the effect of sympathetic block on the surface temperatures of frostbitten hands. In each instance block of the sympathetic trunk was made paravertebrally with 2 per cent novocain at the level of the first rib.

A. Mild case—24 hours after exposure. Vasoconstriction of the terminal arterioles still persisted, but thrombosis had not taken place. Immediately after block was induced the capillary loops in the finger tips again filled, became visible under the microscope, and the skin temperatures rose.

B. Moderate case—24 hours after exposure. Vasoconstriction and thrombosis of the terminal arterioles was present. Sympathetic block failed to cause elevation of skin temperature or refilling of capillaries in the finger tips.

C. Moderate case—6 weeks after exposure. Thrombosis had occurred at the time of injury in this patient. Regeneration of the destroyed terminal capillary loops had not yet begun at the time this block was made.

D. Moderate case—6 months after exposure. Partial regeneration of capillary loops had taken place in this patient. Sympathetic block caused moderate warming of the finger tip at room temperature.

E. Moderate case—6 months after exposure. The same patient as in *D*. Following block patient was kept at room temperature for 10 minutes, during which time active warming took place. The hand was then placed in a cold chamber (temperature −20 degrees C.). Note the precipitate fall in the surface temperature of the hand. This patient's tolerance to cold is still below normal and he is still unfit for high altitude flying.

and desquamation occurred in both hands. Following this there was the usual appearance of the remaining skin and both hands became blue and painful in cold weather. However, these reactions were more marked in the hand treated by the application of cold.

Other methods of releasing peripheral vasoconstrictions are, (a) by applying heat to the body as a whole, which produces a generalized dilatation of peripheral blood vessels in all extremities and thus produces reflex warming (Fig. 20); (b) by the action of drugs (such as amyl nitrate, nitroglycerin, alcohol, the salicylates and papaverine) which affect directly the musculature of the blood vessel walls; (c) by the action of drugs which act primarily upon the autonomic nervous system which in turn acts upon the blood vessel walls through the medium of the sympathetic motor fibers (nicotenic acid, mecholin); and (d) injection blocking of either the peripheral nerve or sympathetic nerve trunks.

As previously stated, if any of these measures are to be effective they must be carried out before thrombosis has taken place at the arteriolar-capillary junctions. Optimum results can be anticipated if the defrosting and the release of vasospasm can be accomplished while the airman is still in flight. Chemical methods for producing relaxation would obviously have great advantages over nerve blocking procedures which require exacting surgical skill.

With this in mind, we have carried out experiments with amyl nitrate, nitroglycerin, alcohol and aspirin. These drugs were administered both to normal persons and to patients who had recently received injuries to their fingers from excessive cold. The effect of these drugs on the peripheral capillary circulation was studied by means of electric thermocouples and simultaneous direct microscopy of the capillaries themselves. Contrary to the generally accepted action as reported in textbooks, none of these drugs caused an elevation of the temperature in the tested parts, nor did they cause a dilatation of the capillary bed (Fig. 19).

Similar experiments with drugs acting upon blood vessel walls through the medium of the autonomic nervous system have also been carried out with similar negative results.

Blocking of the sympathetic nerve trunk and the stellate ganglion with novocain has

been performed in patients suffering at the time from acute vasoconstriction as a result of exposure to intense cold. The results obtained tended to establish the fact that acute dilatation of the peripheral capillary bed could be effected in extremities in which there had not been permanent anatomical injury to the capillary wall, or thrombosis at the arteriolar-capillary junctions. On the other hand, as would be expected in the more seriously affected extremities in which these two pathological changes had already occurred, blocking of the sympathetic trunk and the stellate ganglion failed to produce either a rise in the skin temperatures of the finger tips or a reappearance of blood in the terminal capillary beds (Fig. 21).

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PRIMARY ENDOMETRIOSIS OF THE CERVIX UTERI

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PRIMARY endometriosis of the cervix uteri is rare. Hobbs and Lazar, in a recent case report of this condition, found only one authentic case recorded in the literature. These authors believe that most of the other reported cases of cervical endometriosis have been either extensions from endometriosis of the rectovaginal septum or cases in which cystically dilated cervical glands were found deep in the fibromuscular stroma. However, a careful search of the literature revealed 3 more cases which can be considered as primary endometriosis of the cervix. A 6th case will be reported in this paper.

REVIEW OF LITERATURE

Fels reported the case of a 33 year old unmarried nullipara who, on first admission, complained of vaginal discharge and right lower quadrant pain. Retroflexion of uterus and chronic appendicitis were diagnosed. A ventrifixation and appendectomy were performed. Four months later pain was still present and her menses were irregular. On examination the uterus was found to be well fixed anteriorly. A scar was found, extending from the cervix to the left side of the vaginal vault. Three dark red nodules, each about 4 millimeters in diameter, forming a chain, were present on the left side of the cervix. Neither the scar nor the nodules were seen when the patient was examined at the time of her first admission, nor was there anything in the history which would suggest the possible origin of the scar. A portion of the cervix containing the scar and the nodules was excised. Histological examination showed the squamous cell epithelium of the cervix intact except in those areas where the nodules were located. Here it was absent and there was instead typical endometrial stroma with glands in the premenstrual stage. Recent hemorrhages were seen on the surface. Islands of endometrial tissue and evidences of old hemorrhages were present also in the deeper layers of the fibromuscular wall of the cervix. In view of the persistence of the patient's complaints, Fels considered the possibility of adenomyosis of the uterus. The patient refused another operation.

The superficial location of the nodules and their presence in the immediate vicinity of a scar suggest that this was a case of primary transplantation of endometrial tissue to the vaginal portion of the cervix. In view of the fact that only a small portion of the cervix was available for examination, that islands of endometrium were found also in the deeper layers of the fibromuscular wall, and that the patient's complaints persisted after excision of the lesion, an extension from the rectovaginal septum or from the serosal surface of the supravaginal portion of the cervix cannot be excluded with certainty. These extensions, however, are usually located on the posterior cervical lip. Furthermore, no evidence of pelvic endometriosis was found at the time of the first operation. That islands of endometrium were found also in the deeper layers can be explained by the presence of the scar in which endometrial fragments may have become entrapped.

A second case was reported by Rushmore.

A 26 year old primipara complained of a slight brownish discharge from the vagina which had started 2 days after her menstruation was due. Four years prior to this patient had given birth to a child at term. Version and extraction were done for uterine inertia. Examination revealed a small polypoid nodule of the vaginal portion of the cervix to the right of the os, about a quarter of an inch in diameter, discharging a dark brownish fluid. Histological examination of the excised lesion showed endometrial glands surrounded by decidua. Two and a half weeks later patient returned stating that the bleeding continued. Dark, blood-stained discharge was present. The growth on the cervix was from two to three times as large as before the first removal and there was slight bleeding. The endometrial implant was

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excised and the uterus curetted; normal tissue of early pregnancy was obtained.

The author concluded that at the time of the first operative delivery some of the loosened endometrium probably became attached in the laceration of the cervix and during the ensuing pregnancy underwent "normal hypertrophy." The hypertrophy and bleeding in pregnancy suggested a carcinoma of the cervix but this could be ruled out by the histological examination.

Fobe reported the 3d case in a 23 year old nullipara.

After 2 years of marriage she consulted a physician because of dysmenorrhea and sterility. He diagnosed a retroversion, did a curettage followed by inguinal shortening of the round ligaments. Shortly afterward she became pregnant but aborted in the 3d month. About 1½ years after the operation the patient, then in the 3d month of her second pregnancy, noticed a brownish discharge from the vagina. A small elevation, about the size of a hazelnut, was present on the anterior lip of the cervix. The lesion was excised. The histological diagnosis was endometrioma with decidual reaction. A month later the cervix was completely healed. She had an uncomplicated delivery at term.

This case can be considered as primary cervical endometriosis. The localization of the lesion in the superficial portion of the anterior cervical lip would by itself strongly support such a diagnosis.

Hobbs and Lazar reported the following case:

A 40 year old white woman complained of irregular vaginal bleeding, pain in lower abdomen, and backache. In 1932 she had a uterine suspension, left salpingo-oophorectomy, right salpingectomy, and appendectomy. She had two pregnancies 12 and 14 years ago, which terminated in normal deliveries. A chronic cervicitis with an irregular and enlarged corpus was found. A complete hysterectomy was done. The corpus uteri was enlarged two and one-half times. There were dense adhesions to the left side of the pelvis, the omentum, the bladder, and the sigmoid. There was no evidence of pelvic endometriosis. Examination of the cervix showed the portio covered by normal epithelium and its surface smooth and glistening. The cervical canal was normal with the exception of a small brown area, 0.5 centimeter in diameter, near the external os on the right side. Sections showed typical endometriosis. Many sections from the posterior portion of the cervix and the uterus showed no evidence of endometrial tissue.

In this case the entire uterus was available for examination and endometriosis was found only in the cervix.

The 5th case was reported by Henriques.

A 40 year old married woman, one night during her menstrual period, suddenly had a severe vaginal hemorrhage. Menstrual periods had been normal since the age of 15. The patient had had 9 normal deliveries, the last about 8 years prior to the present episode. For the past 8 years she had been suffering from dysmenorrhea. The vulva was covered with dark red, partly clotted blood On the vaginal portion of the cervix was seen a soft, bleeding, red mass about the size of a hen's egg. Uterus and adnexa presented no abnormalities. A carcinoma was suspected. Histological examination of a biopsy specimen revealed the presence of a hyperplastic endometrial growth. The cervix was amputated. Postoperative course was uneventful. At the time of the publication 18 months had elapsed since the operation, with the patient in perfect health and without any menstrual complaints.

This case is interesting because it closely simulated cervical carcinoma in its clinical manifestations. No case of cervical endometriosis producing such a severe hemorrhage is recorded in the literature. The author did not state whether the amputated cervix was examined histologically. For a complete evaluation of this case it would have been interesting to know whether or not the endometrial growth was confined to the surface of the vaginal portion of the cervix and whether and how far it extended into the cervical canal. Here, as in the first case, extension from endometriosis elsewhere in the uterus cannot be excluded with certainty. It is likely that the lesion was confined to the cervix, in view of the complete cessation of all menstrual complaints after the amputation of the cervix.

CASE REPORT

R.S., a white woman, was seen by one of us (Lash) for the first time in October, 1937. At that time she was 31 years old and had been married for 13 years. She had two spontaneous deliveries (1926 and 1928) and two induced abortions (1930 and 1936). Menstruation began at the age of 15 and was regular. The flow lasted 5 days until her first abortion, 7 days since then. Since her first abortion she had been passing clots with her menstrual flow. Vaginal examination revealed the following: The vulva showed no abnormality; the cervix presented a round, hard, transverse external os; the corpus was somewhat enlarged and firm, and freely movable; the right broad ligament was thickened, fixed and tender; the left ovary was twice the size of normal. A red area, about 1 centimeter in diameter, was noted on the anterior cervical lip, about 2 centimeters from the ex-

Fig. 1. Photomicrograph of cervix showing endometrial tissue partly lined with stratified squamous cell epithelium. × 25.

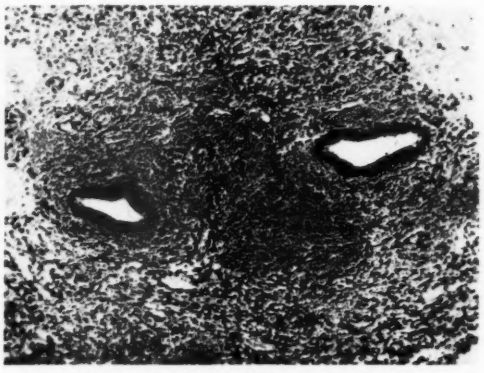

Fig. 2. Low power magnification showing the typical structure of the endometrial glands and the stroma. × 92.

ternal cervical os. Patient was advised to take iodine douches. She was seen again in November, 1941. She complained of backache during menstruation, and of spotting for several days following such menstrual period. Both symptoms had been present for the past 3 years. Pelvic findings were essentially the same as in 1937, except for the presence of a dark red, hemorrhagic, slightly elevated area about the size of a pea on the anterior lip of the cervix. Carcinoma was suspected. The lesion was excised and the uterine cavity was curetted.

Pathological examination revealed a wedge-shaped portion of tissue measuring 1.8 by 1.0 by 0.3 centimeter. On one surface there was a dark red, slightly elevated, circular hemorrhagic area measuring 0.7 centimeter in diameter. It was sharply outlined and its surface appeared eroded. The section surface exposed by dividing the specimen longitudinally showed that the hemorrhagic area was 0.2 centimeter thick and was separated sharply from the underlying fibrous grayish white stroma. Histological slides showed typical endometrial tissue. It was partly lined with stratified squamous cell epithelium which was continuous with the squamous cell epithelium of the adjacent portions of the cervix, and partly it was devoid of an epithelial lining and directly exposed to the surface (Fig. 1). The endometrial glands (Fig. 2) were normal in caliber or slightly dilated. They were lined with a single layer of tall columnar epithelial cells with centrally or basally located nuclei, without evidence of secretory activity. The stroma contained a great deal of extravasated blood, particularly around the glands. It was, in some places, moderately infiltrated with lymphocytes and plasma cells. The cervical stroma in the vicinity of this area of endometrial tissue contained normal or somewhat dilated cervical glands. Some of them were immediately beneath the squamous cell epithelium. Adjacent to this the surface was partly lined with endocervical columnar epithelium, partly it was devoid of epithelial lining, and the superficial layers of the cervical stroma were moderately infiltrated with lymphocytes. Sections from the uterine scrapings showed variations in size and configuration of the endometrial glands. Their epithelial lining was proliferating actively with crowding of the nuclei and formation of papillary projections. There was only little evidence of secretory activity in some of the glands, but in most of them there was none at all. The stroma contained a great deal of extravasated blood. Diagnosis: Cervix-endometriosis, chronic endocervicitis, healing erosion stage II; endometrium-hyperplasia.

Three weeks after the excision the cervix was healed. The menstrual period following the excision lasted 4 days and the flow was decreased in amount. Eighteen months later the patient had no complaints whatsoever. Her menstrual periods have become normal as to interval, amount, and duration.

This is a clear cut case of primary cervical endometriosis. The symptoms started after an induced abortion and subsided immediately after the excision. There was no clinical evidence of endometriosis of the uterus or of the rectovaginal septum.

ANALYSIS OF STUDY

The term "primary endometriosis of the cervix" should be used to designate a condition in which the presence of islands of endometrial tissue is limited to the cervix and in which extension from endometriosis of the rectovaginal septum or from endometrial implants on the serosal surface of the supravaginal portion of the cervix can be excluded.

Secondary involvement of the cervix can be excluded with certainty only if the entire uterus is available for pathological examination (case

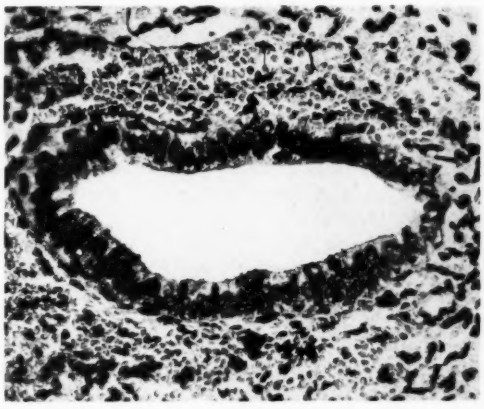

Fig. 3. High power magnification of one of the glands shown in Figure 2. × 295.

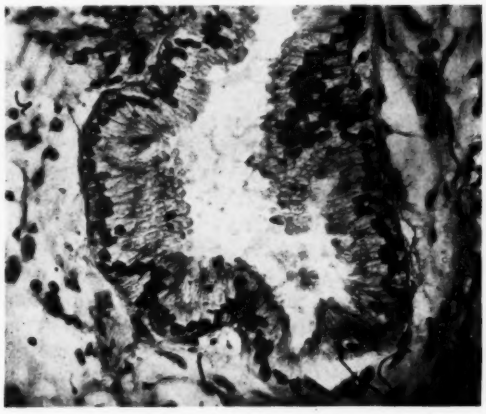

Fig. 4. Cervical gland from the vicinity of the endometrial implant. × 295.

of Hobbs and Lazar). In most instances, hysterectomy was not done because histological examination of the biopsy material revealed the benign nature of the lesion. We believe that, on the basis of the clinical and pathological data available in these cases, the following criteria can be used in favor of the diagnosis of primary endometriosis of the cervix.

1. Localization of the lesion on the anterior cervical lip or to the right or left of the external os. (Secondary extensions of endometriosis into the cervix are usually located in the posterior cervical wall.)

2. Presence of endometrial islands in the most superficial areas of the vaginal portion, immediately beneath the squamous cell epithelium or directly exposed to the surface.

3. Presence of endometrial islands within scar tissue.

4. Absence of clinical evidence of endometriosis of the uterus or the rectovaginal septum.

5. Cessation of the clinical symptoms after excision of the lesion.

From the clinical standpoint the condition is important because in the majority of cases vaginal bleeding or a brownish discharge from the vagina is the outstanding if not the only symptom. This together with the finding of a dark red or brownish red elevated area or nodule on the cervix may easily lead to the suspicion of carcinoma. This actually happened in 3 of the reviewed cases and in the 1 reported by us, and only the histological examination revealed the true nature of the condition.

On the basis of the clinical and pathological findings in the 6 cases of primary cervical endometriosis so far reported it seems likely that the condition is due to grafting of endometrial or decidual tissue fragments. This holds true also for some cases of primary endometriosis of the vagina (Kleine), vulva (Henry), and for most cases of perineal endometriosis (Palmer, Neuweiler, Prager, Violet, Maliphant, Micholitsch). That transplantation of endometrial tissue in the lower genital tract is possible was shown by Schmid. He produced artificial endometriosis of the vagina in 19 women, on whom he had to perform total hysterectomies, by placing endometrial fragments from the removed uterus into the operative vaginal wound without fixing them. These grafts took in most instances, underwent regular cyclic changes and caused regular vaginal bleeding similar to menstruations, which was the purpose of the procedure. It is well known that decidua has been, in a number of instances, inadvertently transplanted into abdominal wounds during cesarean sections, with subsequent development of endometriosis in the abdominal scar. It is, therefore, logical to assume that also in deliveries *per vias naturales*, operative or nonoperative, decidual fragments may become entrapped in cervical lacerations, vaginal or per-

ineal tears, or in episiotomy wounds, and, if conditions for continued growth are favorable, may eventually lead to the development of endometriosis.

Pemberton and others have raised the question why endometriosis of the cervix and the lower genital tract is not more commonly seen, considering the fact that menstrual blood contains pieces of viable endometrium, and a curettage precedes many plastic operations on the vagina. It is questionable whether endometrial fragments normally shed during menstruation are viable enough for grafting on the intact squamous cell epithelium of the cervix. In 5 of the 6 cases mentioned in this paper pregnancies or curettements preceded the development of cervical endometriosis. In one case (1) in which no such history could be obtained the lesion was found in the immediate vicinity of a scar, an indication that there must have been some operative manipulation of the cervix. Although it is accepted by some authors that endometrium cast off during menstruation may, under certain conditions, implant itself on the peritoneum (Sampson), it is not very likely that the intact squamous cell epithelium of the lower genital tract would be a proper nidus for such implantation. Absence of sterile conditions in the cervix as they exist in the peritoneal cavity and the continuous desquamation of the superficial layers of the squamous cell epithelium would militate against the grafting of any kind of endometrial tissue, particularly on the intact epithelium. It seems, therefore, that a traumatic lesion, for instance a cervical laceration, or a vaginal or perineal tear, is a necessary prerequisite for the implantation of endometrium in these areas. The frequent presence of some degree of infection in these lesions would, however, further diminish the chances of successful grafting. Hobbs and Lazar suggest that a change in hydrogen-ion concentration may be a factor in inhibiting the growth of endometrial tissue in the cervix. It would seem that the three factors, namely: absence of sterile conditions, resistance of the intact squamous cell epithelium to implantation, and the frequent presence of some degree of infection in cervical erosions and lacerations, explains sufficiently the relative rarity of primary endometriosis of the cervix.

SUMMARY

A case of primary endometriosis of the cervix is reported. Only 5 other cases of this condition were found recorded in the literature. Clinically it is in the majority of instances characterized by vaginal bleeding with or without dysmenorrhea and by the presence of a dark red or brownish red growth on the vaginal portion of the cervix, either on the anterior cervical lip or to the right or left of the external os. In 4 of the 6 cases malignancy was suspected and could be ruled out only by histological examination. The condition is most probably due to transplantation of endometrial or decidual tissue fragments to the vaginal portion of the cervix. Its rarity can be explained by the resistance of intact stratified squamous cell epithelium to grafting and by the presence of some degree of infection in cervical lacerations and erosions.

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ONE STAGE PANCREATODUODENECTOMY

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EXCISION of the entire duodenum and head and neck of the pancreas in one stage for carcinoma of the ampulla, head of the pancreas, or lower common duct has been successfully performed on a number of occasions by several surgeons. Variations in operative technique have been described including methods for implantation of the pancreatic duct into the jejunum.

The writer in 1937 described a two stage procedure for resection of the entire duodenum, and head and neck of the pancreas — pancreatoduodenectomy (1). This procedure was carried out in one stage for the first time in 1939, but the patient died suddenly on the 4th postoperative day, after minimal reaction from operation. No necropsy was obtained, and the clinical impression of the cause of death was coronary occlusion. A first successful radical one stage resection was performed by Whipple in 1940. A Pólya type gastrojejunostomy, with choledochojejunostomy was the procedure employed in re-establishing continuity of the upper alimentary tract.

The purpose of this report is to record experiences in 8 patients subjected to one stage pancreatoduodenectomy. The technique originally described for the two stage procedure has been modified only in that transection above is carried out through the junction of the lower fifth or sixth of the stomach with the upper four-fifths or five-sixths, instead of at the pyloric sphincter, and transection below is made in the jejunum about 3 to 6 centimeters beyond the ligament of Treitz instead of through the first 1 or 2 centimeters of jejunum, the ligament being completely divided. A choledochojejunostomy is performed instead of cholecystjejunostomy.

At the risk of repetition, a summary of the operative procedure follows (Figs. 1 and 2). Continuous spinal anesthesia is used, if possible, and silk suture technique is followed throughout. The chief steps in the operation are:

1. A high midline, transverse, or inverted-T incision.

2. The head of pancreas and duodenum are mobilized by incision of the peritoneum along the greater curvature of the duodenum. This step aids in ascertaining if the neoplasm has invaded the first portions of the portal vein.

3. The lower stomach is transected and the upper segment is closed. The superior pancreatoduodenal artery is divided near the duodenal wall.

4. The common bile duct is transected at or slightly below the level of the upper margin of the first portion of the duodenum.

5. The neck or proximal portion of the body of the pancreas is transected at the level of or slightly to the right of the superior mesenteric vessels. In the stump of the pancreas, the main pancreatic duct is secured in a hemostat twisted through a 90 degree arc, and ligated. The pancreatic parenchyma is sewed by interrupted interlocking mattress sutures that are not tied too tightly.

6. The superior mesenteric vessels are elevated from the uncinate process of the pancreas and third portion of the duodenum.

7. The ligament of Treitz is incised, thus freeing the duodenojejunal junction and facilitating transection of the jejunum distally.

8. The jejunum 3 to 6 centimeters distal to the ligament of Trietz is transected, and the lower segment is closed by 3 concentric purse-string sutures (linen). Duodenum, head of pancreas, and lower segment of common bile duct are removed.

9. Posterior gastrojejunostomy is done.

10. The transverse mesocolon is incised to permit the first long loop of the jejunum to be brought upward for the choledochojejunostomy. The latter may be done "anteriorly."

11. A jejo-jejunostomy is made below the opening in the transverse mesocolon between efferent and afferent loops of jejunum going to choledochojejunostomy.

From the Department of Surgery, the University of Chicago. This study was facilitated by O. C. Miller Fund for Cancer Research, University of Chicago. Presented before the Chicago Surgical Society, May 5, 1943.

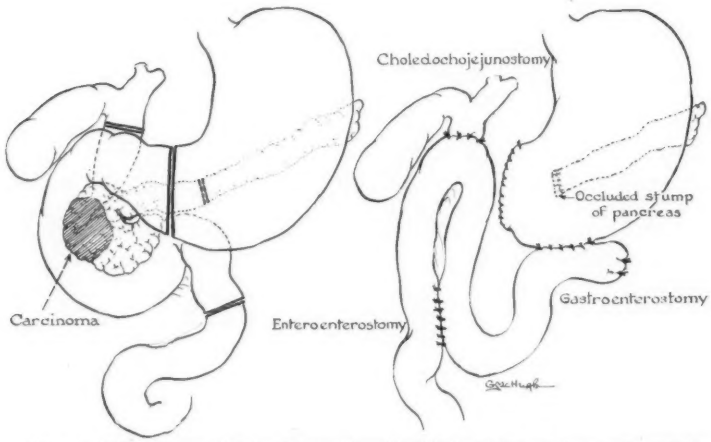

Fig. 1. a, left, Diagram showing transections (double lines) for one stage pancreatoduodenectomy, in excision of carcinoma of head of pancreas. b, Termination of operation—re-establishment of continuity of upper alimentary tract by gastroenterostomy choledochojejunostomy and enteroenterostomy. The stump of pancreas is occluded.

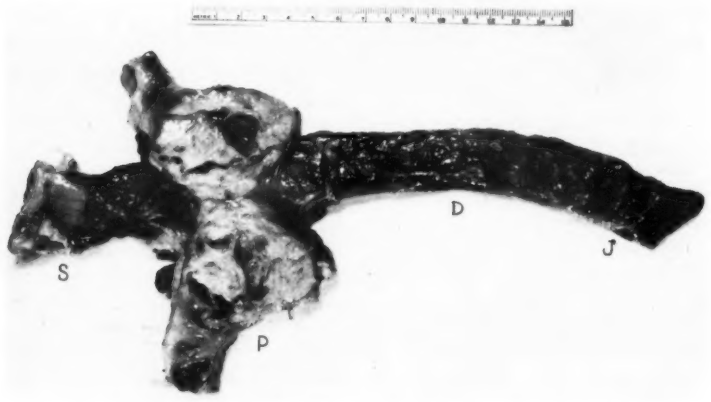

Fig. 2. Surgical specimen, one stage pancreatoduodenectomy Case 6 (289720). *S*, lower portion of pylorus; *P*, bisected head, neck, and proximal portion of body of pancreas with large degenerating and cystic carcinoma in head; *D*, second and third portions of duodenum. *J*, 4 centimeters of jejunum beyond ligament of Treitz.

12. A soft rubber drain is applied to the site of the head of the pancreas and the abdominal wound is closed.

The 8 cases in this series are summarized in Table I. The immediate operative mortality was 50 per cent; 1 patient survived 5 months, dying of carcinomatosis; 1 survived 5½ months, dying of carcinomatosis; 1 is living, well, and doing heavy physical labor 16 months after operation; 1 is living and well after 6 months.

Several questions remain, at present, unsettled in connection with the newer surgery of neoplasms of the head of the pancreas and ampullary region, and only tentative conclusions are now permissible:

One stage versus two stage operation. The two stage operation, in which anastomosis of the obstructed biliary tract to the alimentary tract is the principal objective of the first stage, will remain as the procedure of choice in mark-

edly debilitated patients. It would appear that such an anastomosis (choledochoenterostomy) alone, without additional steps, would suffice. If gastroenterostomy with or without enterostomy is performed, the entire excision might as well be carried out. A choledochoenterostomy may be performed under local anesthesia or with suitable general anesthesia if patient is not a suitable subject for spinal anesthesia. Furthermore, several procedures at the first stage favor the production of adhesions which renders the second stage more difficult.

Choledochoenterostomy versus cholecystenterostomy. Closure of the upper end of the transected common duct, prior to cholecystgastrostomy or enterostomy is not without hazard. Ligatures have slipped or fallen away because of necrosis with escape of bile into the peritoneal cavity and bile peritonitis, or with production of an external biliary fistula. In case there is obstruction in the lower common duct, the latter is dilated and this facilitates its anastomosis with bowel.

A choledochoanastomosis therefore obviates the possibilities of bile leakage at one site, with possible fatal complications, and for this reason is preferable to employment of the gall bladder for anastomosis to the stomach or bowel.

Implantation of pancreatic duct into bowel. Several instances of the successful implantation of the transected portion of the pancreas into the jejunum have been reported. This is an added step in the operation and thus increases the time required for the procedure. Since, normally, pancreatic juice is poured into the intestines it would seem desirable to facilitate this. Evidence to date indicates that some patients get along very well without pancreatic juice secreted into the alimentary canal, absorb normal quantities of fat and have normal stools; others get along well but have large bulky, pasty, foul, light colored stools and absorb less fat than normal; still others tend to steatorrhea and absorb little fat (2).

The successful anatomic implantation of the pancreatic stump into bowel in man has not yet been demonstrated to afford normal or appreciable secretion of pancreatic juice into the bowel. Necropsy findings in such patients after pancreatoduodenectomy have not yet been published to show adequate patency of the reimplanted pancreatic ducts. The report by Jung and Henriet on the completely cicatrized and impervious pancreatic stump after its implantation into jejunum for the eradication of a persistent pancreatic fistula following drainage of a pancreatic cyst, raises the question of whether appreciable pancreatic secretion may obtain after such implantations. It is possible that occluding cicatrization is the normal result of such operations. If this is true the implantation for restitution of external secretion is not justified. The writer continues to occlude the transected pancreatic stumps until evidence is presented that external pancreatic secretion may be restored by implantation procedures.

TABLE I.—SUMMARY OF 8 CASES OF ONE STAGE PANCREATODUODENECTOMY

Patient No. Age	Diagnosis	Date of operation	Course
1. Lat. (213868) 58 yrs.	Carcinoma, head of pancreas	2–2–39	Immediate reaction satisfactory. Died 4th day. No necropsy
2. Th. (248815) 71 yrs.	Carcinoma, head of pancreas	9–26–40	Died 3d day. Necropsy: bilateral aspiration bronchopneumonia
3. Fl. (32544) 57 yrs.	Carcinoma, head of pancreas	6–19–42	Died 5 months 3 weeks after operation. Necropsy: carcinomatosis. Following operation icterus cleared and there was gain in weight for 3½ months
4. Web. (287625) 46 yrs.	Carcinoma of ampulla invading common duct and head of pancreas	7–6–42	Steatorrhea before operation. Normal stools 10 days after operation and continuing well. Gained 25 pounds. Alive, well and working, 16 months after operation.
5. Bl. (290018) 54 yrs.	Carcinoma, ampulla of Vater invading head of pancreas	8–13–42	Died 8 days after operation —uremia without anuria. Necropsy revealed no peritonitis or leakages
6. He. (289720) 35 yrs.	Carcinoma, head of pancreas	8–4–42	Died 5 months after operation. Necropsy: carcinomatosis. Following operation icterus cleared and slight gain in weight for 2 months
7. Las. (306580) 73 yrs.	Carcinoma, head of pancreas ulcerating into duodenum	4–12–43	Died 8th day. Marked asthenia and hypoproteinaemia (4.72 gm. %). No necropsy
8. Go. (2648) 55 yrs.	Large fungating carcinoma, ampulla with regional lymph node metastases	5–17–43	Living and well 6 months after operation. Icterus cleared, pancreatic fistula closed. Back at work (bookbinder).

Another reason for implantation of the transected stump is that it may obviate the development of a pancreatic fistula. This would appear to the author as the best reason offered to date for such a step. Troublesome pancreatic fistulas did not occur in the series of patients presented in this report. In every case a pancreatic fistula did manifest itself several days after operation, but in the survivals it closed after several weeks; in no instance was there appreciable digestion of abdominal wall.

Repair of torn superior mesenteric and portal veins. The neck of the pancreas is in intimate contact with the superior mesenteric vein and just superior and to the left of it is the beginning of the portal vein formed by the union of splenic and superior mesenteric veins. In large carcinomas of the head of the pancreas adhesions of the neck to the superior mesenteric vein or adhesions of the enlarged head to the first portion of the portal vein may be such that in dissection of tissue from these vessels the latter may be opened. In the writer's experience this occurred on three occasions, once in a patient (Case 6) reported in this series. Control of hemorrhage and repair of the injury was successfully carried out as follows:

Firm upward pressure is exerted on the torn vessel by the left index finger inserted into the foramen of Winslow or beneath the superior mesenteric vein. This compresses the veins into a band. After the blood is sponged away, the opening in the vessel is identified and small, straight hemostats are applied closely and serially in a linear fashion to close the tear. The finger is removed and the vessel again fills with blood. None should escape if the opening has been completely closed. The compressing finger is reinserted to collapse the vein. An interrupted suture of fine silk on an atraumatic needle is inserted through the vessel wall just beneath the tip of the first hemostat. As the knot is tied, the hemostat is removed. The same step is repeated for each hemostat in order from above downward.

The high immediate mortality and the grave prognosis for those surviving the operation should not deter continued surgical attack upon this group of neoplasms. Pack and Livingstone cite the years of persistent effort that was necessary to obtain general acceptance of radical gastrectomy for cancer. Quoting from them:

"In 1905 Friedenwald reported 1000 cases of gastric cancer from the surgical literature with the end-results obtained in their care. Two hundred and sixty-six of these patients were subjected to operation. In 138 instances the procedure was simple exploration and closure. There were but nine resections. Only one patient survived for one year and a half. All died of the disease. That is to say, not one patient in 100 received gastrectomy; and but one in the thousand lived for as long as one and one-half years; these were the results twenty-five years after the work of Billroth, and about midpoint from 1881 to the present."

While gastric cancer is much more frequently encountered than carcinoma of the head of the pancreas, a more general and widespread realization of the possibilities of surgical attack upon the latter is to be envisaged as a result of persistent and concerted effort.

SUMMARY

1. Eight instances of one stage pancreatoduodenectomy for carcinoma are recorded. The one stage operation should be performed unless the patient is markedly debilitated when simply a biliary shortcircuiting procedure (choledochojejunostomy) should be done as the first stage.

2. Choledochoenterostomy is preferred to cholecystgastrostomy or enterostomy since reopening of the closed common duct has occurred leading to fatal complications where cholecystanastomoses have been performed.

3. Reimplantation of transected pancreas has not yet been justified on the basis of affording return of pancreatic secretion to the alimentary tract. However, its justification as a method to avoid postoperative pancreatic fistula may be substantiated by further experience until, in addition, evidence is obtained that external pancreatic secretion is effectively re-established by this means.

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REIMPLANTATION OF THE URETER INTO THE BLADDER

Report of a Method Applied to Ten Patients

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NOT many years ago, most urologists viewed with skepticism the advisability of reimplantation of a severed ureter into the bladder. It is our belief, however, that the value and the vital necessity of this operation in preserving renal tissue are now generally recognized. Our questions therefore revolve chiefly about the method or methods best suited to achieve this aim.

The need for the operation is apparently most frequent after bladder resections for neoplasms involving a ureteral orifice; but it will be employed in the occasional case of accidental injury to a ureter (following surgery, labor, or other traumatism), of obstruction of the lower ureter due to intrinsic or neighboring disease or to diverticulum of the ureter or bladder, and it will be used less frequently in certain instances of ureterocele or extravesical opening of the ureter.

Obviously there must be enough ureter remaining to permit anastomosis without tension, and there must be in the kidney enough parenchyma to make the operation worth while. Badly infected bladders or ureters may be further contraindications. There is general agreement in the literature that secondary obstruction causes most of the late bad results, produced chiefly by infection per se or as the forerunner of fibrous tissue formation, with recurrent neoplasm playing an important rôle in some cases. We find that dilation of the ureter and particularly thickening (inflammatory or muscular) of its wall, may lead to unsatisfactory anatomical results although renal function may be largely preserved by the operation.

A considerable though not exhaustive review of published reports has been made. The methods employed may be divided roughly into two groups—with the ureter (a) running directly into the bladder lumen through a stab wound, or (b) entering obliquely according to nature's usual rule governing the entrance of conducting tubes into cavities. Lack of tension is universally recognized as essential. Sutures are sometimes placed outside the bladder, through the ureteral and bladder walls; sometimes they are used only within the bladder; or they may be placed both inside and outside the bladder. Within the bladder, the end of the ureter may be slit on one side only, to make a long elliptical opening, and the end fastened to the bladder mucosa and submucosa only or by penetrating sutures to the whole thickness of the bladder wall. Or the distal centimeter of the ureter may be split in two and each flap secured to the bladder. Many advise in addition, further suturing of the ureteral wall to that of the bladder, on each side, at the point of emergence of the ureter in the bladder lumen. Another method, apparently first advised by Furness, permits the end of the ureter to project freely into the bladder, depending on outside sutures only for fixation; ultimately there is found a small protuberance or bud. All these methods and their variations have their advocates.

Patton drew the ureter through the original intramural ureteral channel and fastened the ureter both inside and outside the bladder. Toulson brought the ureter directly through the bladder wall, split the ureter, and secured each flap by sutures placed through the bladder with knots on the outside. He scarified the bladder wall under the ureteral flaps to encourage fixation. One suture was placed through the ureteral wall and it was fastened to the outside of the bladder. Finally, the bladder was "drawn about the ureter, affording something of an oblique entrance into the

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bladder." More recently Hess has described an intracystic type of reimplantation, applicable to but few selected cases of low ureteral stricture. Practically all authors stress the importance of an extraperitoneal approach (for fear of leakage), the minimizing of infection, the avoidance of tension, and the advisability of placing the bladder at rest by suprapubic or urethral drainage.

Considerable experimental work has been done on dogs, a review of which is not necessary now. The conditions are quite different from those in man. The bladder in dogs is an intraperitoneal organ, hence the operation must be intraperitoneal; the musculature is relatively much thicker; and the bladder must be closed and the wound sutured tight, hence the bladder is not put at rest. Some observations of Vermooten and associates are pertinent to this discussion. They tried oblique transplantation of the ureter by Coffey's ureterointestinal technique, incising the bladder musculature, placing the ureter in the submucous trough, and carrying it through the bladder mucosa at the distal end of the trough, then suturing the muscle over the trough. Three animals thus operated upon died of peritonitis. Then a series of experiments utilized the same principle of oblique implantation by carrying the ureter through a direct opening and laying it in a trough on the inside of the bladder by incising the bladder mucosa, and finally sewing the mucosa over the ureter, the end of which entered the bladder lumen at the distal end of the trough. This was much more satisfactory. Then a series of 10 dogs had one ureter reimplanted by this technique and the other by direct implantation. The comparison of late results was definitely in favor of the oblique entrance. Another observation of these authors indicated the possiblity of ureteral dilation in certain instances "due to infection without any demonstrable obstruction to the ureter."

In our laboratories a small number of dogs (8) have had the ureters reimplanted in the bladder by several techniques. Unfortunately, the pressure of other work interfered with planned experiments. The number in each group operated upon is too small to permit conclusive deductions, and references will be brief.

In 1 dog a bilateral simultaneous reimplantation of the ureters to the bladder through an oblique canal was carried out in an adaptation of the Coffey I method of ureterointestinal anastomosis, vitallium tubes being used in the submucous channel. Two weeks later, the blood urea nitrogen was normal (11.5). The animal was sacrificed 2½ months after operation. The vitallium tubes were lying free in the bladder, with no incrustation, and both ureters were slightly dilated and slightly thickened. This type of experiment possessed no clear advantage and was not repeated.

In 3 dogs one ureter only was implanted into the bladder by the same method, the vitallium tube being omitted. In a 4th animal both ureters were similarly implanted with an interval of 2 weeks between operations. All dogs were sacrificed for necropsy, 2 after a few months and 2 after 11 months. All transplants were satisfactory and all 5 ureters and renal pelves showed no dilation. These few experiences were certainly favorable for the Coffey I method of transplantations into the bladder.

We questioned whether it was necessary to incise the bladder muscle to make a channel, and 3 animals were operated upon by the method which will be described, as used by us on human patients, the submucous channel being made by blunt dissection. The 1st animal died of peritonitis. The 2d was in poor nutritional state and died 3 weeks after operation, badly emaciated. Autopsy disclosed no specific cause of death; the anastomosis was satisfactory and the ureter was not dilated. The 3d experiment of this group is perhaps worth more comment. We were particularly desirous of learning just what happened to ureteral flaps fastened over bladder mucosa. This 3d dog had both ureters reimplanted, with 4 weeks intervening between operations. A month later the blood urea-nitrogen was normal and excretory pyelograms showed normal pelves and ureters. The animal was sacrificed 5 weeks after the last operation, and both ureters and pelves were found normal in size. It was interesting to note that the ureteral strips fastened over the bladder mucosa at the first operation were now tiny nodules

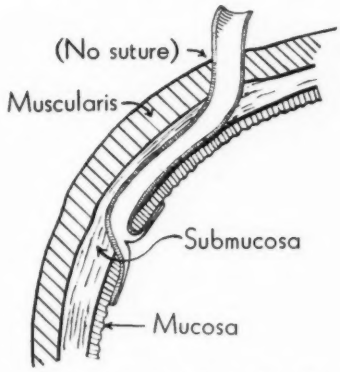

Fig. 1. Diagram of method of reimplantation of ureter into bladder.

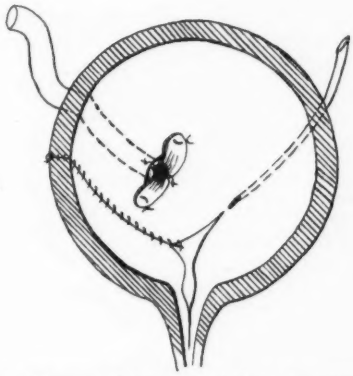

Fig. 2. Diagram of intravesical view of ureteral reimplantation, following bladder resection.

covered with mucosa directly connected with the bladder membrane, and a similar condition with larger nodules was found on the other side. Microscopically one noted the continuity of epithelium between ureter and bladder, with no clear line of demarcation, and indeed no abnormal fibrous tissue was seen about the junction.

In 1933, reporting a series of 41 patients, nearly 75 per cent of whom had bladder resection for carcinoma, the late Edwin Beer forcefully drew attention to the value and importance of reimplantation of the ureter to the bladder in certain cases. He quoted various authors, especially among the French, who had expressed very pessimistic views. In the same clinic, Hyman and Leiter, by 1940, had increased the series to 60 cases. No attempt was made by them to produce an oblique or valvular implantation; the end of the ureter inside the bladder was sutured to the bladder, and the ureteral wall was further anchored to the bladder wall as it entered, by two sutures. Of 27 cases controlled by excretory pyelograms, 44.4 per cent had good results, 26.0 per cent fair functional results, and 29.5 per cent were classed as poor functional results. Of 11 patients having postoperative cystograms, 8 had no reflux up the ureter operated upon, 2 had reflux up the opposite side, and 1 had reflux up both sides.

Just skepticism was expressed of many reports which were made before the days of excretory urography. Many of the kidneys involved may have become functionless. Yet some of the earlier apparently successful cases were substantiated by chromoscopy and even ureteral catheterization, which demonstrated good renal formation. But there was no way to estimate the anatomical result. Now excretory urography affords at once an answer to both queries.

Realizing that obstruction is a large factor in vitiating results, and that infection also plays a major rôle, we have been trying a simple technique during the past 3½ years, applying many of the principles mentioned. The operation is always extraperitoneal. Drains are so placed that only rubber tissue contacts the tissues to diminish fibrous tissue formation, and the drains are removed early. Tension is avoided. Sutures are used only inside the bladder and penetrate mucosa and submucosa only, and the bladder has been kept at rest by suprapubic drainage. Fine chromic sutures—No. 0000—are used, and we have noted no deleterious results from having the knots within the bladder. Sulfadiazine is used to control infection. In 2 cases we used one suture outside the bladder, placed in the periureteral tissue, but otherwise none was employed in this situation as it seems probable that suturing of the ureteral wall would encourage the formation of fibrous tissue and might also interfere with intrinsic blood supply.

The operation (Figs. 1 and 2) is done as follows. A small incision is made at the appro-

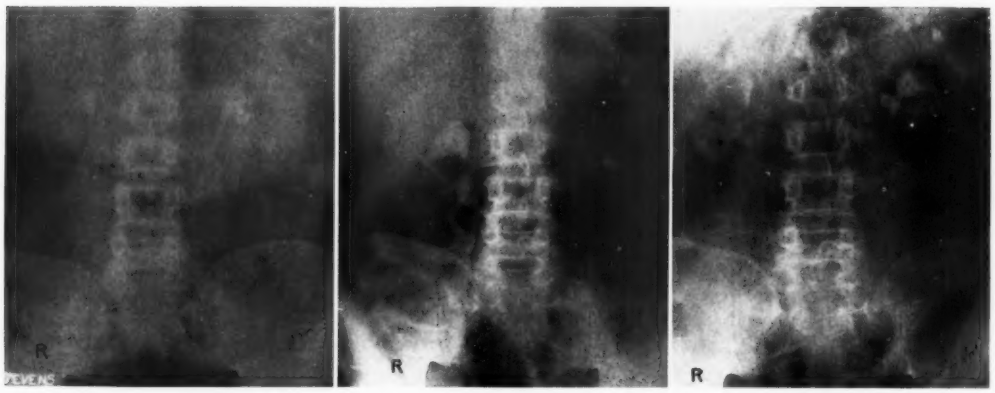

Fig. 3. Roentgenograms, Case 1, G. H., 49 years of age, right ureter, showing views before operation, 6 weeks after operation, and 1 year after operation.

priate place on the bladder wall, penetrating muscle only. A rather pointed curved clamp bluntly dissects a channel under the mucosa downward toward the bladder outlet for about 2 centimeters. A small incision is made through the mucosa over the end of the clamp. Working through a suprapubic bladder opening another clamp is passed retrograde through this channel, and grasps the ureter, the distal centimeter of which has been bisected, forming a "fish-mouth." The ureter is drawn into the bladder through this submucous channel, and the two ends are each fastened to the bladder mucosa and submucosal tissues by a suture of No. 0000 chromic catgut. Finally, at each of the two angles between the ureteral flaps, a similar suture is placed through the mucosa and submucosa of the ureter and bladder, and care is used to avoid the muscular layers. No other sutures are placed. This affords enough fixation if the ureter is under no tension. No catheter is placed in the ureter. A cigarette drain with no gauze exposed is placed near the junction of the ureter and the bladder, but the withdrawal of this is begun the day after operation.

Brief protocols of the 10 patients upon whom this operation was performed, are given. One patient, apparently doing well, died suddenly the night of operation; no autopsy was obtained. There were no urinary fistula and no abscess in any patient. All ureters functioned well. Nine patients had resection of the bladder for carcinoma, and one for long standing fibrous obstruction at the lower end of the ureter. Photographs of the excretory pyelograms of the 9 surviving patients are shown—before operation, about 3 or 4 weeks after operation and (in all but 1) 3 months or more after operation. The earlier postoperative films all indicated some ureteral dilation, but the late ones (8 cases) were of more interest and value. Of 3 patients with some preoperative ureteral or pelvic dilation or both, 2 presented the same condition after operation, and 1 showed increased dilation possibly due to recurrent neoplasm. Of the 6 patients with no preoperative dilation, 1 had no late pyelogram, 3 showed no dilation in the later postoperative films, 1 showed very slight dilation and the 5th had evident hydroureter and hydropelvis as late as 8 months after operation but none 16 months after operation. This man (Case 6) entered the hospital later with a bladder papilloma adjoining the prostatic border anteriorly, but with no evidence of growth about the new ureteral opening on rectal palpation or by cystoscopy.

Function of the kidney associated with the reimplanted ureter, as indicated by the excretion of diodrast in 5 minute films, was as good or better than it was before operation in all cases. There were no postoperative symptoms or abnormal signs in the kidney except for one attack of possible mild pyelonephritis in Case 2.

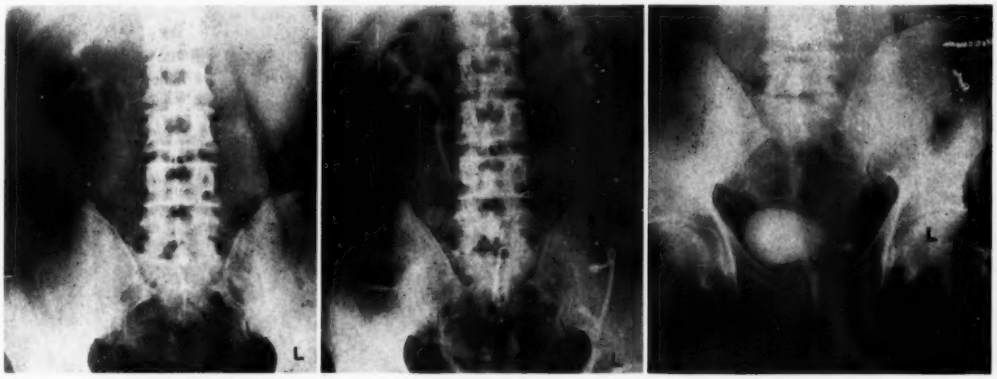

Fig. 4. Roentgenograms, Case 2, G. D., 64 years of age, left ureter, showing views before operation, 27 days after operation and a cystogram 30 days after operation.

We have postoperative cystograms on only 4 patients. Patient in Case 10 who had a long standing ureteral dilation and thickening due to fibrous obstruction, and who had no postoperative improvement in this regard (although the pain symptom was relieved) showed slight reflux 8 months after operation. Patient in Case 2 showed reflux a few weeks after operation (rather early observation). Patient in Case 7 showed no reflux 15 months after operation, and in Case 6 had none 16 months after operation.

CASE REPORTS

CASE 1. G. H., No. 244,004, a 49 year old male, was admitted in January, 1940, with transitional cell carcinoma of the bladder. Resection of the bladder was carried out with reimplantation of the right ureter by the technique here described. After operation the wound was infected, and a secondary closure of the cystostomy was carried out. The right upper urinary tract functioned well and has caused no symptoms in the ensuing 3 years. There was no evidence of recurrence of the neoplasm, and cystoscopy showed a normal bladder wall after 3½ years. A normal excretory urogram was obtained after 1 year.

CASE 2. G D., No. 302,795, a 64 year old male, with recurrent bladder carcinoma was admitted to the hospital in July, 1941, after radium treatment elsewhere through a cystotomy wound. The patient was a diabetic. A bladder resection with reimplantation of the left ureter was carried out by the technique described. The pathologist's report was "papillary transitional-cell carcinoma of the bladder." The postoperative course was satisfactory. The cystostomy tube was removed on the 13th day. Patient was discharged with a dry wound on the 34th postoperative day. Follow-up examinations were not carried out by us as the patient returned to his home in Haiti. He died 8 months later, apparently of carcinoma. Postoperative cystogram showed reflux up transplanted ureter 4 weeks after operation. The excretory urogram showed some pelvic dilation 27 days after operation.

CASE 3. G. M., No. 309,716, a 53 year old male, was admitted to the hospital in October, 1941, with a carcinoma of the bladder, about the size of a dime and adjoining the left ureteral orifice. Mild left hydronephrosis and hydroureter were present. Bladder resection with reimplantation of the left ureter was performed by the procedure described. The pathological diagnosis was "transitional-cell carcinoma," and the tumor was found to have invaded the lower portion of the ureter. The postoperative course was uneventful except that the cystostomy closed slowly because of mild obstruction from an enlarged prostate. Patient was readmitted 3 months later, and a single cyst of the right kidney was partially excised. Urinalysis at this time was normal. There were no symptoms referable to the left upper tract. Pyelograms up to that time showed a moderately hydronephrotic left upper urinary tract. Regular cystoscopic follow-up examinations were made and 1 year from the time of the original operation a recurrence was found. Subsequently the patient developed carcinomatosis. Ureterointestinal transplantation and thoracic chordotomy were done with some palliation. We feel certain that the eventual disappearance of function of the left side was due to the massive tumor recurrence.

CASE 4. P. L., No. 311,423, a 62 year old male, was admitted to the hospital in October, 1941, with a transitional cell carcinoma of the bladder near the right ureteral orifice. A bladder resection with reimplantation of the right ureter was carried out by the method described. His postoperative course was satisfactory though the cystostomy healed slowly. A course of sulfadiazine was given. Patient was discharged in good condition on the 49th postoperative

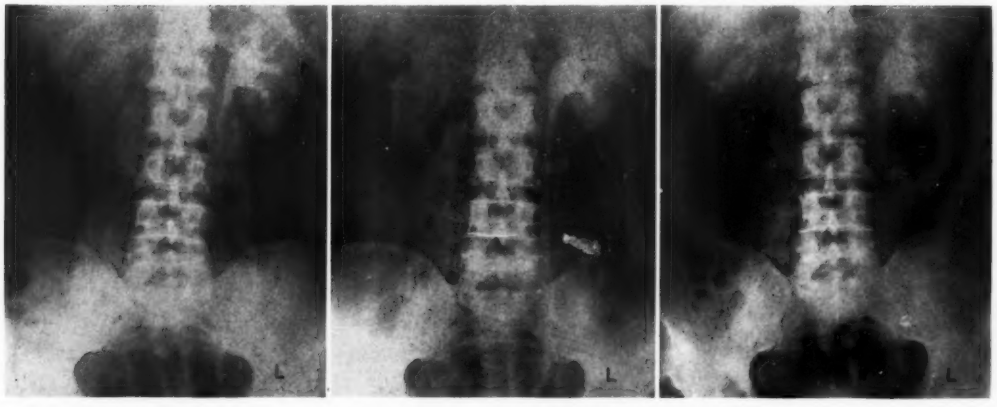

Fig. 5. Roentgenograms, Case 3, G. M., 41 years of age, left ureter, showing views before, and 27 and 77 days after operation.

day. He has had occasional pain in the right flank, never lasting over a few hours. The last urine examination found 25 white blood cells per high power field in a centrifuged specimen. Tiny papillomas were fulgurated cystoscopically 1 year after operation. Excretory urograms demonstrated slight dilation of the right pelvis, 4½ months after operation.

CASE 5. F. C., No. 310,405, a 47 year old male, was admitted to the hospital in October, 1941, with a bladder tumor. Complete study found the patient in good condition except for the lesion near the left ureteral orifice. Under general anesthesia, bladder resection and reimplantation of the left ureter were carried out as by the method outlined. The specimen removed measured 6 by 4 by 2.5 centimeters. The pathological diagnosis was "transitional-cell carcinoma of the bladder." Approximately 4 hours after operation the patient was conscious and apparently in good condition when he suddenly became cyanotic and expired within 5 minutes. Autopsy was not performed. Death probably was due to massive pulmonary embolism. There seems to be no reason to believe that the specific technique of the reimplantation had any connection with the fatal outcome. The ureter was not dilated before operation.

CASE 6. J. M., No. 319,999, a 41 year old male, was admitted to the hospital in February, 1942, with a transitional cell carcinoma of the bladder near the left ureteral orifice. Bladder resection with reimplantation of the left ureter was carried out. Except for a nonspecific postoperative epididymitis, the postoperative course was entirely satisfactory. Pa-

Fig. 6. Roentgenograms, Case 4, P. L., aged 62 years, right ureter, showing views before operation and 20 days and 4½ months after operation.

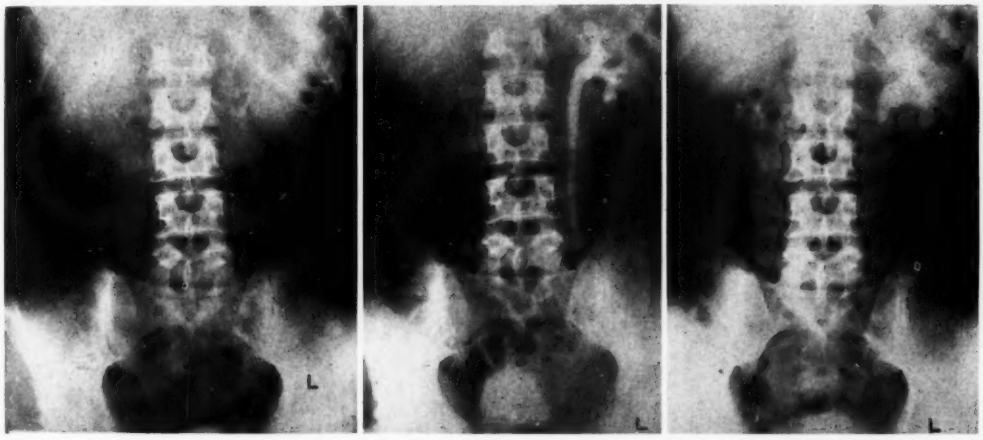

Fig. 7. Roentgenograms, Case 6, F. M., 53 years of age, left ureter, showing views before operation and 12 days, and 8 and 16 months after operation.

tient was discharged in good condition with wound healed on the 27th postoperative day. Subsequently recurrent papillomas have been fulgurated cystoscopically. Seven months after operation intravenous indigocarmine appeared in 3 minutes from the right ureteral orifice and in 5 minutes from the left neostomy. Excretory urograms show moderate pelvic dilation 8 months after operation—cause undetermined. Sixteen months after operation the excretory pyelogram is within normal limits. At a subsequent cystotomy, the neostomy was easily catheterized and could clearly be seen to pass obliquely through the bladder wall. A cystogram found no ureteral reflux.

Case 7. F. M., No. 76,006, a 54 year old male, was admitted to the hospital in January, 1942, complaining of terminal hematuria of 4½ months' duration. Cystoscopy revealed a slightly raised, flat surfaced, ulcerated lesion approximately 3 centimeters from the right ureteral orifice. Biopsy was reported as "epidermoid carcinoma of the bladder." Complete investigation found no other abnormalities. A bladder resection was done, and a piece of tissue 6 by 4 by 1 centimeter was removed. In the center of this mass the lesion was found to be 1.5 by 1 centimeters. The muscle, however, was not invaded. The pathological report on the operative specimen was "transitional cell carcinoma of the bladder." The right ureter was reimplanted into the bladder by the technique here described. Except for temperature elevation (due to a mild bronchopneumonia) the first 3 days, the postoperative course was uneventful. Cystostomy tube was removed on the 14th postoperative day. Patient was discharged with a dry wound on the 30th postoperative day. A course of sulfadiazine was given. Subsequent visits to the clinic have demonstrated a completely satisfactory

course. The last cystoscopy done 1 year after operation found no evidence of tumor, healing was complete, and the urine was clear. Nine months after operation indigocarmine injected intravenously appeared simultaneously from both sides, in good concentration, in 2 minutes. Cystogram demonstrated no ureteral reflux. Excretory pyelograms show no dilation of the side operated upon.

Case 8. R. V., No. 318,025, a 30 year old male, was admitted to the hospital in February, 1942, with a large papillary tumor of the bladder between the left ureteral orifice and the bladder outlet. Total cystectomy was refused at this time. A bladder resection with reimplantation of the left ureter into the bladder was carried out by the technique described. Subsequently radon seeds were implanted in the suture line. Eventually recurrences were found. Later bilateral ureterointestinal transplantation and total cystectomy were done and the patient has

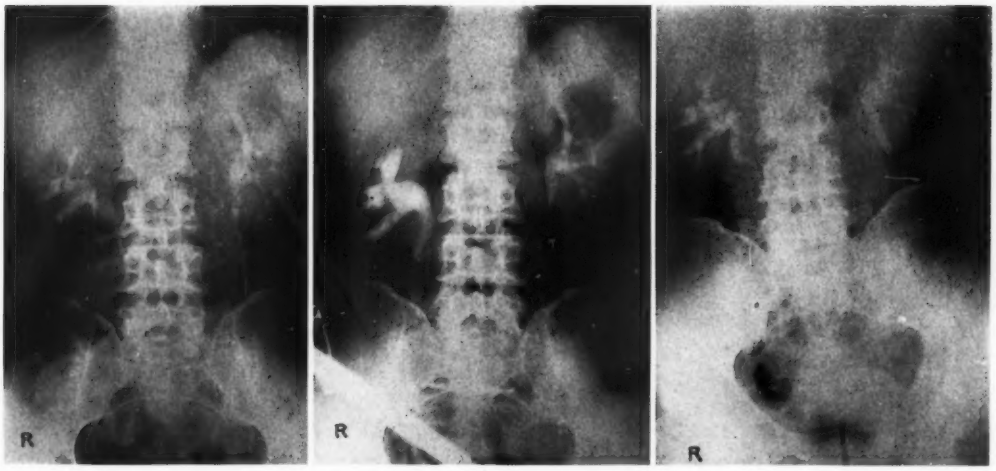

Fig. 8. Roentgenograms, Case 7, F. M., aged 54 years, right ureter showing views before operation and 12 days and 3 months after operation.

returned to work. The reimplantation of the left ureter following resection of the bladder was satisfactory, and patient never had symptoms referable to this. Intravenous pyelograms demonstrate the good anatomical result.

CASE 9. F. A., No. 333,981, a 53 year old male, was admitted to the hospital in August, 1942, with an epidermoid carcinoma of the bladder just over the left ureteral orifice. A bladder resection with reimplantation of the ureter was done by the technique described. Except for a mild wound infection the postoperative course was satisfactory. Patient was discharged with wound healed on the 28th postoperative day. He was readmitted 4 months later with symptoms of left pyelonephritis, which promptly subsided. As can be noted in the pyelograms, the hydronephrosis had increased. A local recurrence of the tumor seemed quite likely as induration could be made out rectally in the region of the reimplantation. Cystoscopically, however, no recurrence could be made out 5 months after operation and intravenous indigocarmine appeared in good concentration from the right ureteral orifice in 8 minutes and from the left neostomy in 9 minutes. At the time he was symptom free. Excretory urograms demonstrate marked hydronephrosis.

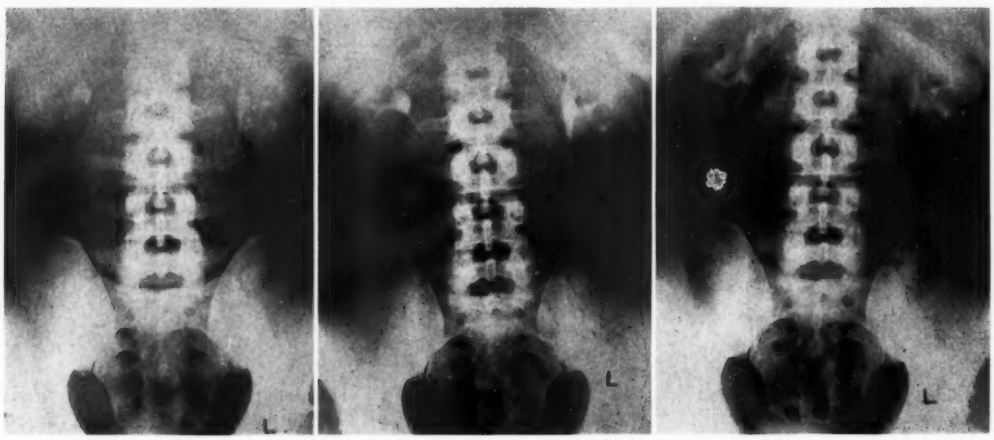

Fig. 9. Roentgenograms, Case 8, R. V., 30 years of age, left ureter, showing views before and 45 days and 7½ months after operation.

Fig. 10. Roentgenograms, Case 9, F. A., 52 years of age, left ureter, showing views before operation and 13 days and 4 months after operation.

CASE 10. R. R., No. 251,771, a 39 year old female, was admitted to the hospital in August, 1942, with pain in the right flank, for surgical treatment of right hydronephrosis and hydroureter. Ureteral meatotomy and dilations had been given a thorough trial without effect. At operation considerable heavy fibrous tissue was found about the ureterovesical juncture which seemed to cause the obstruction by constricting the ureter. The ureter generally was thickened and fibrous. Reimplantation of the dilated ureter was done. The postoperative course was satisfactory and patient was discharged on the 31st day after operation without pain, in good condition, and with wound healed. Seven months after operation there were normal urinalysis and marked symptomatic relief, although occasional mild right flank pain was reported. She had gained 22 pounds. The pyelograms show but little improvement. The normal urinalysis after 3 months without drugs is clear evidence of improvement, as we had had evidence of persistent pyuria for 4 months before operation.

RÉSUMÉ

The value of reimplantation of the ureter in the bladder is generally recognized. The type

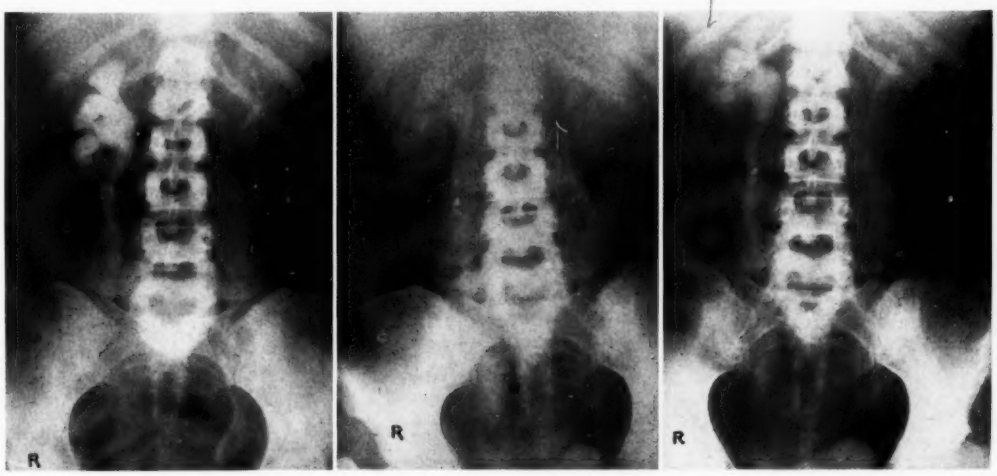

Fig. 11. Roentgenograms, Case 10, R. R., 39 years of age, right ureter, showing views before operation and 10 weeks and 9 months after operation.

of cases in which it is employed, and the various methods advised are discussed.

Some experimental work is referred to, including a few applications to dogs of the operation here described for man.

The details of that operation are given, with brief protocols of 10 patients. Nine of these had carcinoma of the bladder and 1 had low fibrous ureteral obstruction. Urograms before and after operation demonstrate little or no dilation of the upper tract following operation in 5 patients having normal urograms before operation. Ureters dilated before operation have remained so afterward. Increased ureteral dilation as noted in the late postoperative pyelogram was seen but once (Case 9), and this patient probably had local recurrence of carcinoma. There were no perivesical abscesses or fistulas.

In all patients, function of the kidney on the side operated upon, as demonstrated in the 5 minute films of the excretory urogram series, was as good after operation as before, or better.

Postoperative cystograms in 4 cases show no ureteral reflux in 2 instances, some months after operation; slight reflux in 1 patient who had had a dilated and thickened ureter above a fibrous obstruction, 8 months after operation; and definite reflux a few weeks after operation in the 4th case.

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A NEW TYPE OF BONE PLATE AND SCREWS

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THE modern conception of bone surgery, especially the open reduction and the experimental use of steel in fracture treatment was pioneered by W. A. Lane (3, 4). He is credited with first using metallic fixation in 1892, and his plate design continues to enjoy considerable popularity. Following Lane's work various metals were used in the construction of bone plates; namely, steel, German silver, silver, aluminum, copper, brass, and vanadium. These, however, have proved so intolerable to tissues they have been replaced for the most part by two recently developed alloys: vitallium and stainless steel. These latter metals are well tolerated by tissues. Vitallium, a cast metal, contains casting faults while stainless steel, a ductile metal, is, consequently, much tougher and less brittle.

In the past 30 years there have been few changes in plate structure from Lane's original plate. Souttar, in 1913, introduced a plate made of "thin material," and molded in the shape of an angle-iron, one side of which was inserted into slots previously made in the bone fragments. The opposite side of the plate contacted the cortical surfaces, and contained holes through which screws were passed, thus anchoring the plate to the bone. Twenty-five years later Hawley and Padula presented their angle-iron plate which was constructed of stainless steel. In design and mechanics the Hawley-Padula and the Souttar plates are similar.

Keeping in mind the advantages and disadvantages of plates previously used we have attempted to design a bone plate which better serves the purpose of fixation and yet eliminates, as much as possible, the faults inherent in the former ones. The type of plate we wish to present here is constructed of austinitic (18-8) stainless steel. It is 20 centimeters long, 1.4 centimeters wide, and has an overall thickness of 0.4 centimeter (Fig. 1). The actual thickness of the metal is but 0.07 centimeter. Oval slots 1 centimeter long and 1 centimeter apart serve as screw holes. These slots are slightly wider than the shaft diameter of a 6-32 or a 6-20 stainless steel machine screw. The plate has a corrugated structure and is roughly "M" shaped in cross section (Fig. 3).

In analyzing the various components of the plate one will note that it contains several advantages:

1. The stainless steel construction reduces to a minimum the opportunities of plate fracture and, in addition, makes for easy molding to the contour of the bone.

2. The length of 20 centimeters will allow adequate bridging of all single and many double fractures. Because of the light gauge of the metal it can be readily cut to the desired length by the operator at the time the fracture site is exposed. This makes it unnecessary to have plates of different lengths at the table.

3. The oval slots have replaced the conventional round, counter-sunk screw holes. These oval screw holes have several distinct benefits. When countersunk screw holes are present, the various drill holes in the bone must conform to each other within a few thousandths of an inch of accuracy. Otherwise, when the screws are sunk into position the near cortices will tend to separate. With the plate containing oval slots there is no need of this extreme accuracy in drilling.

The oval slots assist the operator in obtaining accurate approximation of the fragments; e.g. if the plate is in place, the screws in the center of the slots, but have not been completely tightened, and the fragments are well alined and the operator, on examining the fracture site finds a gap between the ends of the fragments, impaction is easily and accu-

From the Department of Orthopedic Surgery, College of Medical Evangelists, Los Angeles General Hospital, service of Dr. G. Mosser Taylor.

Fig. 1. New type of bone plate. Top view showing oval slots for screws.

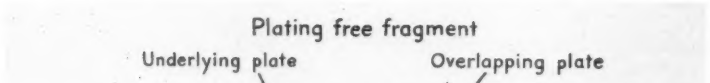

Fig. 2. Drawing illustrates how plates may be stacked and staggered lengthwise to form a continuous metal truss joining all three fragments into one solid unit.

rately accomplished without loss of position by exerting firm pressure on the distal end of the distal fragment.

4. The corrugated shape adds considerably to the strength of the metal. The alternate ridges allow two or more plates to be stacked, nested, or laminated one on the other in-

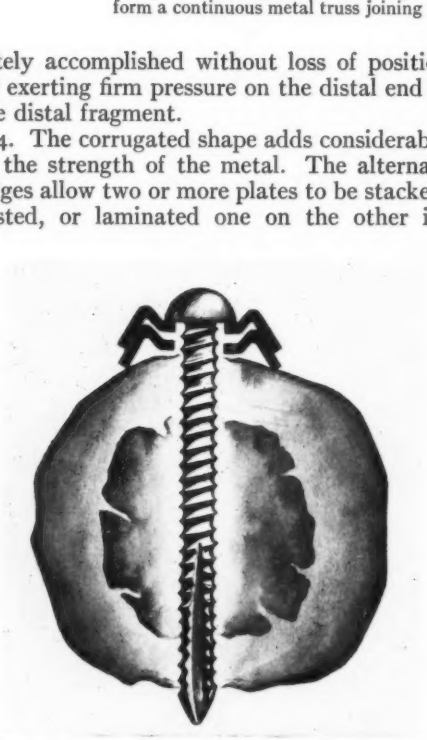

Fig. 3. Cross section drawing of bone illustrating how plates can be stacked one on the other. Screw is in oval slot and holding plates firmly to bone. Note that only the legs of the lower plate touch the bone allowing space for callus to grow under plate. The drawing also shows a cross section of the plate, which is roughly "M" shaped.

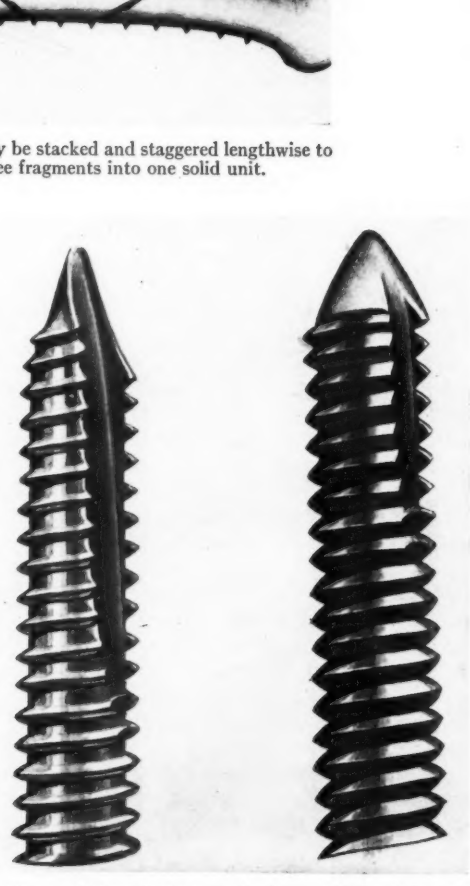

Fig. 4. Enlarged photograph of screw designed by authors, left, and conventional type bone screw, right. The screw at left has a long single flute with offset point forming a perfect tap which cuts deep even threads beginning with the first turn. The screw at right etches on the first few turns but does not cut even threads in the bones and it lacks the holding power of the authors' screw.

creasing the actual thickness only by the gauge of the metal itself; by 0.07 centimeter per plate. The stacking of plates also provides a form of leaf spring action (Fig. 3).

In addition to stacking, the corrugated shape permits lengthwise staggering of the plates. The importance of this is illustrated by the following problem: Let us assume we are confronted by a double fracture of the femoral shaft; one fracture being in the upper third, the other in the lower third. In dealing with this condition it would be necessary to use two conventional plates—one bridging the lower which would, in turn, make a point of weakness at the middle fragment or where the two independent plates tend to contact each other. By utilizing corrugated shaped plates one can take advantage of their ability to be staggered lengthwise and thereby form a continuous truss of metal from the upper across the middle and to the lower fragment. The weak point at the middle fragment is thus removed (Fig. 2).

On the femur 2 or more plates (2 for a single fracture) are recommended. Six screws are used for fixation. For the tibia and the humerus 1 plate, held in place by 4 or 6 screws, is adequate. However, in our opinion, 4 of the tuk-tap screws will hold sufficiently in tibial and humeral plating jobs. Whenever possible the fracture site should also be transfixed by a screw. Of the various screws we have found the 6-20 (18-8) stainless steel tuk-tap type to be the most satisfactory. This screw has a sharp offcenter point, a long, single flute and contains 20 threads to the inch (Fig. 4). The offcenter point allows for cutting the bone threads on the first turn of the screw. This type of tap facilitates the passage of the screw through the bone with approximately 40 per cent less force than is usually required by the older type bone screws. Instead of using a No. 32 drill for the preliminary drilling, we find the smaller No. 36 drill will provide a more perfect fit. This smaller drill hole permits a greater bone to metal ratio and a consequent increase in holding power. Other screws call for the larger No. 32 drill. The 6-20 tuk-tap screws we employ contain the same ratio of alloys as does the plate. We have found the holding power of the 6-20 tuk-tap screw to be approximately 46 per cent greater than the Sherman 6-32 screw. This holding power comparison between the 6-20 stainless steel and the Sherman screw is also borne out by the experimental work of W. F. Lyon (5, 6).

The plates and screws described have been devised for the larger bones. For the bones of the forearm a plate of the same design but of smaller dimensions is employed. For the small plate a 4-24 stainless steel screw has been found to serve adequately the purpose of fixation.

These plates and screws have been used in more than 70 cases of fractures of the long bones since September 1, 1940. The majority of the patients were operated upon at the Los Angeles General Hospital. In addition to this series Joldersma reports 32 cases in which he used this form of internal fixation.

SUMMARY

A new type of bone plates and screws is presented and advantages of each described.

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THE TREATMENT OF INTERTROCHANTERIC FRACTURES OF THE FEMUR WITH A HANGING CAST

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IN an analysis of the causes of death in patients with intertrochanteric fractures of the femur at St. Louis City Hospital, Leydig and Brookes (2) found pneumonia to be the cause in from 39 to 53.4 per cent of the fatal cases. Decubitus ulcers have always been a major problem in the care of these patients. To overcome some of these complications, the use of a hanging cast has been tried. Up to the present time, over 50 cases have been treated by this method. In this series, the mortality rate has been reduced from 39.3 to 18 per cent, and the duration of hospitalization reduced from 84.7 days to 62.3 days (Table I).

The first casts used were ordinary, padded midthigh casts. It was soon learned, however, that if enough weight was attached to a cast for reduction of the fracture, pressure sores were found on the leg in 39.4 per cent of the cases, and of these, 16.9 per cent had a foot drop when the cast was removed. Skin-tight casts were then tried and were found to be as ineffective in preventing pressure sores as the padded casts. Dr. J. A. Key suggested that a Steinmann pin inserted through the distal end of the femur and incorporated in the cast might prevent the pressure sores and peroneal nerve paralyses with accompanying foot drop. The use of such skeletal traction has eliminated the complications mentioned. No local infections of the soft tissues or bone injury has resulted from the use of the Steinmann pins.

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TABLE I.—COMPARISON OF HANGING CAST AND OTHER TREATMENT

	Hanging cast	Other forms of treatment (2)
Number of cases	50	302.0
Average age in years	70.6	68.1
Average age patients expired in years	79.6	74.0
Average hospital days	62.3	84.7
Mortality per cent	18.0	39.3

Fig. 1. A 78 year old man with an intertrochanteric fracture up in a wheel chair on the 3d day after injury. Note that the footpiece of the chair has been turned up allowing the cast to hang free.

The hanging cast is applied in the following manner. The patient is given a sedative, either a barbiturate or morphine sulfate. A Steinmann pin is then inserted through the lower end of the femur, under local anesthesia. Stockinet and sheet wadding are applied in the usual manner from the midthigh region down to, and including, the foot. Felt padding is applied over the bony prominences. An ordinary midthigh cast is then applied, incorporating the Steinmann pin in the cast. The thickness of the cast is varied with the size and condition of the patient. A frail woman of 80 years would receive as light a cast as possible, whereas a man of 50 years would get a much heavier one.

The cast is applied with the knee in 30 to 40 degrees of flexion, and plaster loops made from narrow plaster slabs are incorporated in the cast at the knee and at the foot (Fig. 1). The loops, which serve as a means of attach-

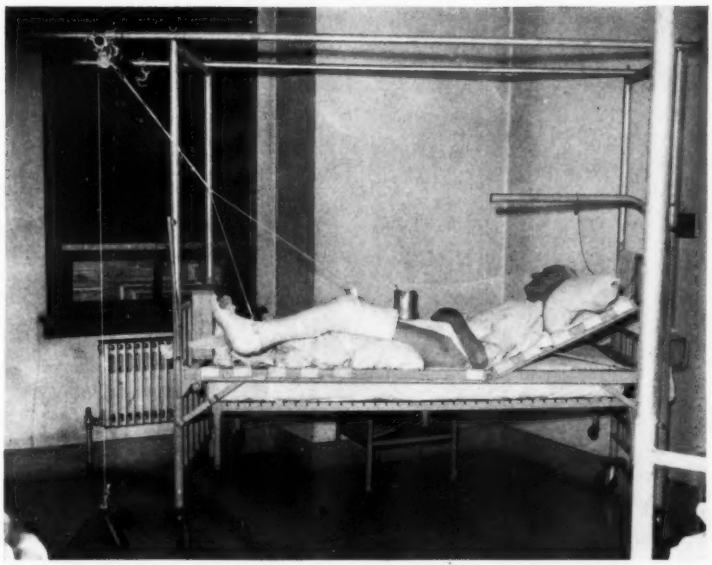
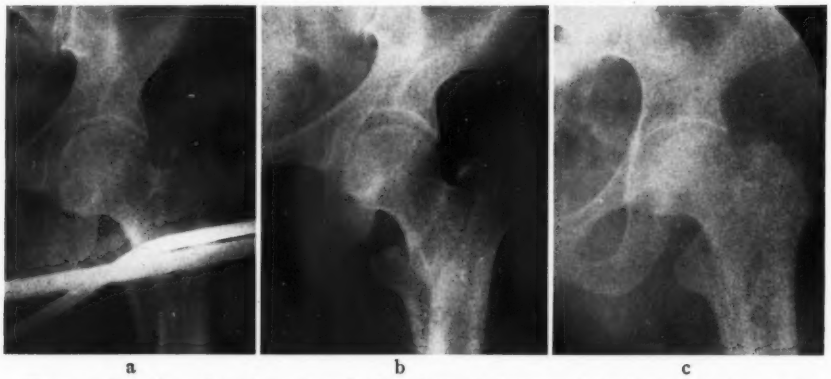


Fig. 2. Same patient as in Figure 1 in bed with traction applied through the cast.

a b c

Fig. 3. a, X-ray film of intertrochanteric fracture of the femur as patient entered the hospital on the day of the accident, before the application of a hanging cast. b, Same patient after 17 days of treatment in a hanging cast. c, X-ray film showing callus formation which was present when the cast was removed on the 44th day. Patient was discharged from the hospital on crutches on the 49th day after admission.

ing ropes to the cast for traction, are placed on the anterolateral aspect of the cast, so that when traction is applied, the external rotation of the leg is corrected (Fig. 2). As soon as the plaster is sufficiently hardened to stand the strain, ropes are tied to the loops, and from 20 to 35 pounds of traction is applied to the cast through an overhead pulley at the foot of the bed. The line of traction is similar to that used in a Hodgen splint. The pulley can be moved so as to obtain as much abduction of the femur as desired. A folded pillow is placed beneath the cast at the knee for support. The traction is used only while the patient is in bed (Fig. 2), the weight of the cast acting as traction while the patient is in a wheel chair or up



a b c

Fig. 4. a, Comminuted trochanteric and subtrochanteric fracture of the femur seen by roentgenogram on admission to the hospital with a temporary splint applied by an ambulance driver. b, Same patient after 4 days' treatment in a hanging cast. c, Same patient 4 weeks after admission, showing callus formation. Cast was on for a total of 46 days, the patient leaving the hospital on crutches 51 days after admission.

on crutches. It was found that a permanent loop tied at the junction of the cast rope and the traction rope minimized the amount of adjusting necessary, and made it possible to entrust an attendant with returning a patient to his bed without supervision.

One to 3 days after the application of the cast, each patient is placed in a wheel chair for a period of 2 to 6 hours daily. One pillow is placed in the wheel chair beneath the patient and another under the cast. The footboard on the side of the affected extremity is turned up so that the leg hangs without support. With the patient using the overhead bar for support, he can usually be moved by one attendant. If gentle traction is applied to the cast as the patient is placed in the wheel chair and if no pressure is applied over the fracture site, the pain is minimal. Elderly patients are kept upright in the wheel chair by means of a folded sheet passed about the waist and tied to the back of the chair. No patient has refused to be up in a wheel chair because of pain.

If he is able, the patient is instructed to use crutches after the 3d week. The cast is permitted to hang, but weight bearing on the affected extremity is not allowed.

The reductions obtained by the use of a hanging cast are similar to the reductions obtained by other forms of treatment (Fig. 3, a, b; Fig. 4, a, b). New bone is often detectable by roentgenography at the end of the 4th week (Fig. 4, c). The casts have been removed from these patients after an average of 43.4 days (Fig. 3, c), and the patients discharged from the hospital on crutches. Weight bearing, however, is not allowed until the 10th or 12th week. Follow-up of these patients reveals no shortening or deformity not present when patients were discharged from hospital.

SUMMARY

1. Fifty cases of intertrochanteric fracture of the femur have been treated by the hanging cast method.

2. The mortality rate for intertrochanteric fractures has been reduced 54.2 per cent.

3. Complications, such as pneumonia, decubitus ulcers, stiffness of knees and ankles, weakness from lying in bed, etc., are less frequent as patient can get out of bed early.

4. The reductions have been as good as the reductions obtained by other methods.

5. The time required for the formation of new bone and, consequently, the duration of hospitalization have been reduced.

6. The hanging cast is technically a simple method of treatment.

7. No instances of nonunion have occurred.

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TRAUMATIC WOUNDS OF THE ABDOMEN

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DAMAGE to abdominal viscera may be caused by weapons or missiles which penetrate the parietes or by blunt trauma without penetration. In the latter group may be included "blast" injuries, due to pressure waves from high explosives transmitted through water.

Penetration of the abdomen may occur not only through the anterior, lateral, and posterior walls, but also through the thorax and upward through the pelvis, with wounds of entrance on the thorax, buttocks, sacral areas and perineum, or even the neck and thighs. Wounds of organs vary according to speed, size, shape, and nature of the missile. These wounds range from small punctures of hollow or solid organs to large lacerations which may completely divide the intestine or tear it from its mesentery. Solid organs may be completely disrupted. Any structure in the path of the missile may be damaged. Wounds of the great vessels, including the aorta, cava, iliac and renal trunks, seldom reach the surgeon. The small bowel, because of its spread, is most frequently damaged, next the solid organs, liver, kidneys and spleen, then the colon and stomach.

Nonpenetrating force has definite predilection for certain organs. The liver is the solid organ most frequently injured and may even be lacerated by the ends of fractured ribs. The majority of the small intestine being freely movable, it is seldom injured except in its fixed portions, that is, the duodenum, the upper jejunum and lower ileum. The kidneys and spleen may be ruptured by blows on the flanks, back, or lower chest. Fractures of the pelvis may be accompanied by injury to the bladder, urethra, or pelvic colon and rectum. Blast injuries, particularly when the compression force is exerted through water, may vary from contusion of organs to perforations of hollow viscera and rupture of the liver, the kidneys, or the spleen. Late perforation or internal hemorrhage following contusion may take place.

DIAGNOSIS

In the absence of definite information from inspection of the wounds showing that the missile must have entered the peritoneal cavity, other signs are surprisingly misleading unless there is obvious prolapse of viscera or intestinal contents from the wound or passage of blood from the stomach, intestinal tract, or bladder. Evidence of shock in early cases is in proportion to the loss of blood, either internally or externally. Vomiting is not present as often as would be expected. Pain and rigidity are extremely variable and do not differentiate from a mere wound of the abdominal wall. The boardlike rigidity from chemical irritation so typical of perforated peptic ulcer is not usually seen in these cases until late, when bacterial peritonitis has set in. The x-ray is of some value in determining the position of retained projectiles but is seldom of other value in early cases. Microscopic examination of the urine for blood is sometimes of value, as is the finding of blood on the glove after rectal examination. The presence of shock out of proportion to the wound is one of the best indications of internal damage with hemorrhage. In the last analysis, however, surgical exploration of the wound and of the abdomen in all cases in which there is the slightest suspicion of visceral injury is the final and most important diagnostic procedure.

In nonpenetrating wounds the diagnosis is even more difficult, since we have no real wound and often not even visible abrasion or contusion to guide us. Shock which is not relieved spontaneously and quickly may indicate hemorrhage from the liver or spleen and is an indication for operation. Vomiting is unreliable unless the vomitus contains blood. Persistent significant pain and muscle spasm are important when present but may be absent until bacterial peritonitis sets in. Free gas in the cavity is likewise a late phenomenon. The presence of blood in the urine is significant but is not necessarily an indication for

emergency surgery of the kidney unless there are signs of internal hemorrhage. When blood is present, cystoscopy, or safer and simpler, an air cystogram will be valuable. When intraperitoneal hemorrhage is suspected paracentesis with an 18 gauge spinal needle is a safe and valuable procedure. In case of any doubt, however, exploratory operation is justified as the risk of doing an unnecessary operation even on slight evidence is less than the danger of a delay of twelve or more hours until there are definite signs of peritonitis.

TREATMENT

In early cases shock is due to internal hemorrhage and can be effectually combatted only by surgical hemostasis. Mortality increases directly with the amount of hemorrhage, the mortality in the Louisville General Hospital cases being 17.2 per cent with hemorrhage of less than 500 cubic centimeters, 41.5 per cent with hemorrhage of 500 to 1000 cubic centimeters, and 64.6 per cent with hemorrhage of over 1000 cubic centimeters. Abdominal wounds stand transportation and delay poorly for this reason. They should, therefore, have first priority in evacuation to the closest point where operation can be carried out. When active intraperitoneal bleeding is going on it cannot be counteracted by intravenous medication, and delay in operation to treat shock may be fatal. However, immediate operation does not preclude adequate treatment for shock, which can be carried on as well on the operating table as in a shock ward. Adequate replacement therapy with blood or plasma should be started at the earliest possible moment and continued before, during, and after operation.

Gentle expeditious surgery with the patient under suitable anesthesia will not appreciably aggravate shock particularly when adequate replacement therapy is going on. In this connection it must be emphasized that replacement, preferably with blood, should equal or better, *exceed* the estimate of blood loss. In late cases arriving at a surgical center those with large hemorrhage will have been eliminated by death, and shock will be due to other causes. In such cases reasonable delay for resuscitation measures is justified.

ANESTHESIA

The necessity for complete exploration makes the best possible relaxation advisable. For this reason, spinal anesthesia, unless contraindicated by marked hypotension, is to be preferred. Local and regional anesthesia are too time consuming and do not allow adequate exposure. Gas induction followed by ether and adequate oxygen is probably the most useful general anesthesia, although intravenous anesthesia, ethylene or cyclopropane may have a place.

INCISION

Of the conventional incisions the long, rectus splitting, or long, transverse incision between the costal margin and the iliac crest give the best all around exposure. Extensions at right angles to these incisions may be necessary and should be made without hesitation, rather than limit exposure. In injuries localized to one upper quadrant, oblique incisions, with division or excision of the costal arch may be useful. Many thoracoabdominal wounds, particularly on the left side, may be best exposed through the thorax and damage to the contents of both cavities repaired. Lower abdominal, rectal, and bladder injuries may be exposed through the midline.

EXPLORATION

When the abdomen is opened the first consideration is the control of the hemorrhage which may have been increased by respiratory or other motion during the induction of anesthesia and by the release of pressure when the abdomen is opened. At this point mechanical suction is most valuable, as recognition of bleeding points is often impossible until the cavity has been cleared of clots and liquid blood. Blind clamping in a pool of blood may be disastrous and it is at this point that the surgeon unaccustomed to emergency surgery loses precious time. Digital control of large vessels is most valuable. The portal vein, hepatic artery, and even the celiac axis may be compressed between the thumb and a finger inserted through the foramen of Winslow, effectively halting most bleeding from the upper abdomen. The mesenteric or splenic vessels may be compressed in their course, as

may the short renals. Pressure on the iliac trunks will likewise be effective in the lower abdomen. Direct control of bleeding points may now be accomplished under vision. In the case of the liver, suture may be possible. Temporary pressure will suffice in many instances since the bleeding is largely venous. In other cases tamponade with strips of muscle from the abdominal wall may be necessary. Packing with gauze should be avoided whenever possible since it is frequently followed by infection and secondary hemorrhage. Detached and devitalized portions of liver should be removed and a drain placed down to the wound to permit the escape of bile. Damage to the spleen is usually treated by splenectomy, except when the wound is small and hemorrhage has stopped spontaneously. Attempts at repair are usually futile and waste of both time and blood.

The kidneys and their pedicles may be exposed transabdominally by incising the peritoneum lateral to ascending or descending colon and reflecting the bowel and its mesentery medially. Most wounds of the kidney with active hemorrhage are best treated by nephrectomy because of the additional blood loss during repair. Severe fragmentation is also an indication for removal, making sure in all cases of course that a second good kidney is present. Smaller wounds may be sutured. Before closure the incision in the posterior peritoneum should be sutured and the retroperitoneal spaces drained through a stab wound in the flank. Following the control of hemorrhage a systematic search of the hollow viscera should be made. The sequence of this examination depends upon the estimated track of the missile, and the location of the incision but no portion of the gastrointestinal tract should be neglected, as a viscus may have moved from its position at the time of injury. In the upper tract particularly, attention should be paid to easily overlooked wounds of the abdominal esophagus and posterior wounds of the stomach and duodenum. If present or suspected these latter may be exposed by an incision or enlargement of a wound on the anterior surface of the stomach or duodenum. In other cases, exposure through the gastrocolic or gastrohepatic omentum may suffice. In both large and small intestine, hematomas in the mesentery may hide perforations in the mesentric border. The transverse portion of the colon is usually examined first if the wound is high, since it is the most accessible portion, the ascending and descending portions being left until exposed by exploration of the small bowel. Systematic exploration of the small bowel without undue exposure is greatly simplified by placing a suture or Babcock forcep on the first presenting loop, reading the gut either up or down from this point to one end and then returning to the marker and going in the opposite direction until all has been examined.

REPAIR

Most lacerations of the bowel even when multiple lacerations are close together should be repaired rather than resected. Simple pursestring or Lembert sutures of fine material usually suffice. Occasionally the conversion of two nearby openings into one by cutting between them, makes closure easier without decreasing the lumen of the bowel too much. When laceration, contusion, or destruction of blood supply makes resection necessary in the small bowel, primary anastomosis should be done. In the large bowel, exteriorization with the formation of a colostomy is better. The repair of wounds of the colon should be supplemented by a tube cecostomy to relieve tension. Enterostomy following repair of the small bowel is not recommended, since it is not so effective as suction on an indwelling gastric or Miller-Abbott tube. Few wounds of the pancreas are seen, both because of its size and coincident injury to great vessels. Repair is usually futile, except for injury of the tail, when resection may be carried out. The wound should be drained. Wounds of the bladder should be sutured in layers and cystostomy performed or a Foley catheter inserted. Small wounds of the ureter may be repaired and a drain inserted. Occasionally simple drainage will suffice and the fistula will often close spontaneously. Division of the ureter near the bladder may be treated by reimplantation into the bladder. If higher, lumbar ureterostomy is advisable if there is loss of substance and repair is impossible. Drain-

age of the urine is the primary consideration. Before closure the peritoneal cavity should be cleaned of all blood, clots, bits of tissue, and intestinal, biliary or urinary contents. Lavage is not only useless but harmful. Sulfanilamide or sulfadiazine should be implanted in dose of 5 to 15 grams especially near perforations. Careful abdominal closure in layers may be contraindicated by the condition of the patient. Even if this is not the case, through and through closure with heavy nonabsorbable material may be advisable because of the high incidence of postoperative evisceration. Drainage of the peritoneal cavity to prevent or treat future bacterial peritonitis is futile. However, drains should be inserted to take care of leakage of urine, bile, or pancreatic fluid, when indicated. The retroperitoneal tissues should be also drained if they have been contaminated by bowel contents.

POSTOPERATIVE TREATMENT

The treatment of shock by intravenous administration of blood and plasma is continued as long as necessary. Replenishment of protein by this means may also be necessary later in the convalescence. Decompression of the bowel by suction through an indwelling tube is a routine and should be instituted as early as possible to prevent tension on sutured wounds of the gastrointestinal tract and to prevent the ileus which frequently occurs. Other routine measures for the prevention of complications common to abdominal surgery are also placed in operation. Further evacuation to the rear should not be undertaken until the patient is out of shock and improving.

SUMMARY

Wounds of the abdomen are of the penetrating and nonpenetrating variety. The diagnosis of penetrating or perforating wounds is usually obvious. That of nonpenetrating wounds may be difficult. Any abdominal organ may be involved in the penetrating type, and almost any in the nonpenetrating type. The principal cause of death in both types is hemorrhage with peritonitis as a cause of secondary importance. Delay in evacuation or operation for the treatment of shock is not justified in either type, since shock is due to hemorrhage.

OBSERVATIONS ON THE TRANSUDATE IN INTESTINAL STRANGULATION

I. The Effect of Adrenal Cortical Extract on Its Toxicity

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THE cause of the disturbances and death following interference with the blood supply to the intestine has been studied extensively for many years. Excellent summaries of various aspects of the literature will be found in the reports of Cooper, Herrin and Meek, Donaldson and associates, and Harkins. It appears that in intestinal strangulation, the lethal factors associated with intestinal obstruction are superimposed upon those resulting from death of the intestinal tissue. The cause of death from strangulation of the intestines has been attributed to many factors. Most prominently considered in this connection have been the nerve reflex, the fluid loss, and the toxemic theories. The importance of nerve reflexes in contributing to ill-effects and death cannot be denied, but the fact that animals succumb even when the strangulated intestine is denervated rules this out as the primary mechanism. Similarly local fluid loss and loss by vomiting play a major rôle in cases of strangulation but the evidence is controversial, to say the least, that the amounts so lost are sufficient to explain the rapid downhill course in every instance. A large body of evidence has accumulated that some toxic material is absorbed into the blood stream in strangulation and contributes the major rôle in establishing the subsequent course and outcome. Innumerable attempts have been made to identify the toxic material and to determine the mode of its action. Acetylcholine, adenosine, histamine, and complex protein decomposition products have been implicated. The toxic material has been obtained from the lumen, wall, and transudate of the strangulated intestine.

Our present studies have been upon the transudate from strangulated intestine of the dog, because the material it contains could more readily be considered absorbable into the blood stream than material obtained from the lumen or wall. The procedure was as follows: In the dog anesthetized with ether the inframesocolic portions of the small intestine were strangulated by tying off their blood supply, and at the same time the lumen was obliterated at both ends. This part of the intestine was completely enclosed in a rubberized bag to collect the transudate in a manner similar to the method employed by Foster and Hausler. The operation was carried out under aseptic precautions. After 4 to 6 hours the bag was released, and the transudate which had collected was emptied into a sterile container for testing. The fluid usually appeared light pink in color and turned reddish brown on standing.

EFFECT OF TRANSUDATE FROM STRANGULATED INTESTINE ON CAPILLARY PERMEABILITY

While the chief concern about the vascular action of the toxic material in strangulation has been its vasodepressor effect, we believed that it might be worth while to investigate its action on capillary permeability, for if such an effect were present it would account for widespread plasma loss and contribute to the shock-like condition encountered in intestinal strangulation. Menkin has developed a simple way of determining the effect of substances on capillary permeability and has shown that in an inflamed area a substance, "leukotaxine," is found which increases capillary permeabil-

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ity. This finding has been confirmed by Freed and Lindner among others, and more recently Shleser and Freed have shown that a similar response can be obtained with peptone.

In carrying out the Menkin test, freshly obtained transudate was used. An 0.2 cubic centimeter portion of transudate was diluted with an equal quantity of isotonic saline and injected intracutaneously into the shaved abdominal skin of a rabbit. As a control, a similar quantity of isotonic saline alone was injected in another portion of the abdominal skin. After 3 to 5 minutes 10 cubic centimeters of a 1½ per cent solution of trypan blue was injected intravenously. Within a few minutes there was a concentration of dye at the site of the transudate injection, and none where the control solution was injected. In this manner the transudates from 18 dogs obtained within 4 to 6 hours of intestinal strangulation invariably gave a positive Menkin test in 18 rabbits. A similar positive reaction was obtained in 8 rabbits after 8 specimens of transudate were passed through a Seitz filter, although a weaker reaction sometimes occurred with the filtered material.

It is thus apparent that a substance capable of increasing capillary permeability is present in the transudate from strangulated intestine, and the possibility is thus established that part of the reaction to strangulation results from such toxic material entering the blood stream and increasing capillary permeability. The result of such a widespread increase in capillary permeability would be to decrease plasma volume and thus cause a form of shock.

NEUTRALIZING ACTION OF ADRENAL CORTEX EXTRACT ON THE CAPILLARY PERMEABILITY EFFECT OF TRANSUDATE FROM STRANGULATED INTESTINE

The possibility that adrenal cortex extract could neutralize the increase in capillary permeability caused by this transudate was suggested by the action of adrenal cortex extract in neutralizing leukotaxine (Menkin; Freed and Lindner) and peptone (Shleser and Freed). To test out this possibility, we carried out a 3d series of intracutaneous injections in the rabbits described. In this series equal parts of adrenal cortex extract[1] and unfiltered transudate were injected and the effect was compared with that from injection of transudate alone. It was found, on comparing the skin reaction at the site of the adrenal cortex extract-transudate injection with that of the transudate injection, that adrenal cortex extract completely neutralized the capillary effect shown by the transudate in all 12 separate tests.

This result suggests a possible mode of therapy in intestinal strangulation, since evidence has recently been adduced that adrenal cortex extract may decrease capillary permeability in other localities than in the skin (Shleser and Asher). It might explain in part at least the beneficial result following the use of adrenal cortex extract obtained by Wohl and associates in experimental intestinal obstruction and that obtained by Heuer and Andrus with adrenal cortex extract in counteracting the vasodepressor action of injections of aqueous extracts of closed intestinal loops.

THE NEUTRALIZATION BY ADRENAL CORTEX EXTRACTS OF THE TOXIC EFFECT ON MICE OF THE TRANSUDATE FROM THE STRANGULATED INTESTINE OF THE DOG

The suggested benefit of adrenal cortex extract in neutralizing the capillary effect of transudate was further explored by observations on mice. Mice were selected as the test animal in these further studies because their small size permitted the use of larger series for comparison. It has been shown by Donaldson and associates that mice are susceptible to the toxic action of the contents of dog's strangulated intestines. In the present studies the transudate of strangulated intestine from 8 dogs operated upon on the same day were pooled and used. Preliminary tests showed that this material, like the preceding, gave a positive Menkin reaction in rabbit skin. The transudate was diluted with an equal part of isotonic saline and injected intraperitoneally in a group of mice, each mouse receiving 0.4 cubic centimeter of the transudate-saline solution. At the same time another group of mice each received intraperitoneally 0.4 cubic cen-

[1]Generous supplies of the adrenal cortex extract used in these studies were supplied by Dr. D. Klein of the Wilson Laboratories.

TABLE I.—EFFECT OF ADRENAL CORTEX EXTRACT UPON MORTALITY OF MICE INJECTED INTRAPERITONEALLY WITH TRANSUDATE OF DOGS' STRANGULATED INTESTINE.

Material injected	No. of mice in series	No. of mice dead in 24 hours	Mortality %
Transudate in saline—0.2 c.c. transudate in 0.2 c.c. isotonic saline per mouse	40	34	86
Transudate plus adrenal cortex extract—0.2 c.c. of each per mouse	43	21	48

TABLE II.—EFFECT OF VARYING TIME OF INJECTION AND TOTAL AMOUNT OF ADRENAL CORTEX EXTRACT UPON MORTALITY OF MICE INJECTED INTRAPERITONEALLY WITH TRANSUDATE OF DOGS' STRANGULATED INTESTINE.

Material injected	No. of mice in series	No. of mice dead in 24 hours	Mortality %
Transudate in saline—Control group—0.2 c.c. transudate in 0.2 c.c. isotonic saline per mouse	87	61	70
Transudate plus adrenal cortex extract—Group I—0.2 c.c. of each per mouse	54	23	42
Transudate plus adrenal cortex extract—Group II—0.2 c.c. of each per mouse preceded 1 hour earlier by 0.2 c.c. of cortex extract	38	12	34
Transudate plus adrenal cortex extract—Group III—0.2 c.c. of each per mouse preceded 1 hour earlier and followed in an hour by injections of 0.2 c.c. of cortex extract	21	7	33
Transudate plus adrenal cortex extract—Groups I, II and III	113	42	37

TABLE III.—EFFECT OF VARYING RATIO OF ADRENAL CORTEX EXTRACT TO TRANSUDATE OF DOGS' STRANGULATED INTESTINE INJECTED INTRAPERITONEALLY UPON MORTALITY OF MICE.

Material injected		Ratio adrenal cortex extract to transudate	No. of mice in group	No. of mice alive at end of		
Transudate c.c.	Adrenal cortex extract c.c.			3 hrs.	7 hrs.	14 hrs.
0.5	0.0	Control	4	0	0	0
0.5	0.1	1:5	4	0	0	0
0.5	0.25	1:2	4	1	0	0
0.5	0.5	1:1	8	4	0	0
0.5	1.0	2:1	4	4	0	0
0.1	0.5	5:1	4	4	4	2
0.25	0.5	2:1	4	4	0	0
1.0	0.5	1:2	4	0	0	0

TABLE IV.—EFFECT OF SEITZ-FILTRATION OF TRANSUDATE OF DOGS' STRANGULATED INTESTINE UPON MORTALITY OF MICE WHEN INJECTED INTRAPERITONEALLY

Material injected	No. of mice in series	No. of mice dead in 24 hours	Mortality %
Unfiltered transudate in saline—0.2 c.c. transudate in 0.2 c.c. isotonic saline per mouse	40	34	86
Seitz filtered transudate in saline—0.2 c.c. filtered transudate in 0.2 c.c. isotonic saline per mouse	19	1	1
Seitz filtered transudate plus adrenal cortex extracts—0.2 c.c. of each per mouse	20	1	1

timeter of a mixture of equal parts of transudate and adrenal cortex extract. The measure of the effect was the death rate of the mice within 24 hours. It will be seen from Table I that 86 per cent of the control mice receiving transudate were dead in 24 hours, while in those receiving adrenal cortex extract in addition the mortality rate was 48 per cent, a reduction in mortality of about ½. It was also noted that the animals which survived after receiving adrenal cortex extract were much livelier than the surviving animals which received only transudate.

The results in the first series were confirmed in a second series of mice in which the pooled transudate from 7 dogs was used. In this series, the mice were divided into 4 groups: the first 2 groups were handled as in the preceding series; the 3d group received an additional adrenal cortex extract injection (0.2 c.c. per mouse) 1 hour before the transudate-adrenal cortex mixture was injected; and the 4th group received not only this preliminary adrenal cortex extract injection but also a subsequent one (0.2 c.c. per mouse) 1 hour after injection of the transudate-extract mixture. It will be seen from Table II that 70 per cent of the control mice receiving transudate were dead in 24 hours, while only 37 per cent of those receiving adrenal cortex extract in addition succumbed in this period; the mortality in this series, as in the last, was reduced

about ½ by adrenal cortex extract. In this series also, as in the first, the surviving animals receiving cortex extract were livelier than those receiving transudate alone. No significant change in mortality was observed to follow the administration of adrenal cortex extract before or both before and subsequent to the injection made at the time the transudate was administered, although the trend was to reduce the mortality from 42 per cent (group I of Table II) to 34 and 33 per cent respectively (groups II and III).

A much clearer quantitative relationship between the amounts of transudate and adrenal cortex extract was shown in another series of mice in which the ratio was varied. In them the pooled transudate from 8 dogs was used. In this series, the mice were divided into 8 groups of 4 each (and 1 of 8) and the proportion of transudate and adrenal cortex extract injected simultaneously was varied. The measure of effect in these mice was their survival at the end of 3, 7, and 14 hours. The results are summarized in Table III, and it is clear from this table that survival was lengthened when the proportion of adrenal cortex extract to transudate increased, the results being surprisingly consistent.

It would appear from these experiments that adrenal cortex extract definitely neutralizes, at least in part, the toxic action of transudate of strangulated intestine.

As early as 1911, Murphy and Vincent found that the toxic material of strangulated intestine obtained from the lumen of the cat lost its toxicity when passed through a Berkefeld filter. As has been pointed out we found that Seitz filtration of the transudate lessened but did not abolish the Menkin reaction in rabbit skin. We tested the toxic effect of the transudate in our first series of mice in a similar way by passing the material through a Seitz filter. As shown in Table IV, the filtered transudate was much less toxic to mice than was the unfiltered material. Thus only 1 mouse in 19 succumbing in 24 hours, a mortality of 1 per cent, and this low mortality was also present when adrenal cortex extract was added. However, the animals receiving adrenal cortex extract were more lively and active than those receiving filtered transudate alone. In fact, the latter animals were all lethargic and appeared ill. Thus, adrenal cortex extract appears to prevent even the milder toxic effects of Seitz filtered transudate from strangulated intestine.

The lessening of toxicity by Seitz filtration does not necessarily indicate that most of the toxicity is due to bacteria contained in the transudate. It must be recalled that Seitz filters remove not only bacteria when present but, being positively charged electrically, they prevent the passage of positive charged "inanimate" material in suspension (Kramer). It is therefore quite possible that the toxic material in the transudate consists in large part of such a positively charged suspension, or that the toxic material is adsorbed in large part upon such a suspension.

SUMMARY AND CONCLUSIONS

Experiments utilizing the peritoneal transudate of the dog's strangulated intestine have shown that:

1. The transudate increases capillary permeability as demonstrated by the Menkin reaction in rabbit skin. This effect is somewhat decreased when the transudate is passed through a Seitz filter. This effect of unfiltered and filtered transudate on capillary permeability is neutralized by adrenal cortex extract.

2. The transudate is toxic to mice when injected intraperitoneally, making them ill, lethargic and leading to a high mortality within 24 hours. These ill-effects are markedly reduced by passing the transudate through a Seitz filter, particularly as far as 24 hour mortality is concerned. A less striking but nevertheless definite reduction of mortality is effected by adding an equal amount of adrenal cortex extract to the unfiltered transudate before injection, the mortality being reduced by about ½. In addition, adrenal cortex extract lessens the lethargy of the mice surviving 24 hours, and this is also found to be true in mice receiving Seitz filtered transudate. There is suggestive evidence that the neutralizing effect of adrenal cortex extract upon the reaction of mice to transudate is proportional to the relative amounts of each employed; increasing the relative proportion of adrenal

cortex extract produces a definite effect on the survival time of the mice.

It is concluded from these experiments that toxic material which can pass into the blood stream is produced by strangulation of the intestine. Such absorbed toxic material may account in large part for the effects observed in strangulation. These experiments further suggest that the toxic material acts in part to increase capillary permeability leading to escape of plasma, so producing shock. Adrenal cortex extract neutralizes the action of the toxic material in the transudate by preventing the increase in capillary permeability and possibly in other ways not revealed by our experiments. On the basis of our experiments the use of adrenal cortex extract in clinical intestinal strangulation appears worthy of trial.

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THE DERMATOME PATTERN GRAFT AND ITS USE IN RECONSTRUCTION OF THE HANDS

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MANY extensive and severe burns to the hands, involving both the dorsal and palmar surfaces, are being seen in the present conflict.

For the reconstruction of injuries to the cutaneous covering of the hands, the free transplant of the skin holds many advantages over the prolonged pedicle flap operations. The various indications for the use of each type of free skin graft and the pedicle flap in hand reconstructions have been recently described by Koch. The many advantages of thick split grafts as developed by Blair and Brown (1, 2) and others in the repair of these injuries are apparent. The introduction of the dermatome into plastic surgery by Padgett has resulted in a method of obtaining uniformly large grafts of a predetermined thickness with sharp straight edges, more suitable for smaller reconstructions than the razor graft. By means of the dermatome in the manner to be described, grafts of a specific pattern may be obtained for the reconstruction of extensive injuries of the hands and other regions.

TECHNIQUE

The following procedure has been utilized for the past 2 years in cutting pattern grafts of split thickness skin for the reconstruction of certain areas. In my experience, the suggestion of utilizing the dermatome to cut certain complicated patterns of skin by painting out the undesired portion with talcum powder has not proved feasible, because the dermatome will not uniformly pick up and follow such a devious route. Reconstructions of the dorsum of the hand present complicated patterns due to prolongation of cicatrix along the fingers. In this situation, the dermatome pattern graft, as outlined here, has proved to serve a definite place. Under tourniquet the scar of the hand is carefully separated in its entirety from the remaining subcutaneous base (Fig. 2).

From the Lawson General Hospital, Atlanta, Georgia.

In exerting traction on the scar during excision, it is necessary to be careful not to cut into vessels and nerves which are pulled up with the portion of tissue being excised. By this painstaking dissection, the entire cicatrix including its extensions along the fingers is removed. Bleeding vessels are caught as they are cut and tied with finest silk. A large piece of hard faced sterile filter paper is pressed over the denuded area and the outline of the surface to be grafted is imprinted on the paper, which is then removed and trimmed with scissors until an accurate pattern of the defect is obtained. The skin and subcutaneous surfaces of the pattern are distinctively marked with indelible pencil, so that each surface may be readily identified. If this precaution is not carefully observed, the pattern graft will be cut backward so that the right side will be fitted into the left side of the defect. Wet gauze sponges are placed on the hand, and it is then firmly dressed with a sterile roller gauze bandage following which the tourniquet is released. The donor site for the skin graft which has previously been prepared is cleaned with ether, and an estimate of the area of skin to be removed is made. The dermatome and donor site are coated with cement, and the dermatome drum is then pressed to the donor site and a split skin graft of the desired thickness is secured. On the dorsum of the hand, a graft of 0.018 inch is sufficient in thickness for satisfactory coverage and protection. The entire sheet of skin is cut with the dermatome to the desired length and separated from the donor site. The drum is then placed in its stand and the pattern previously prepared is placed on the skin still adherent to the drum, taking care that the skin surface of the pattern is in contact with the raw surface of the graft as marked when the pattern is made. It will be found that the pattern will stick firmly to the skin graft, due to the capillarity action of the filter paper (Fig. 3). With a scalpel the skin is now

Fig. 1.

Fig. 2.

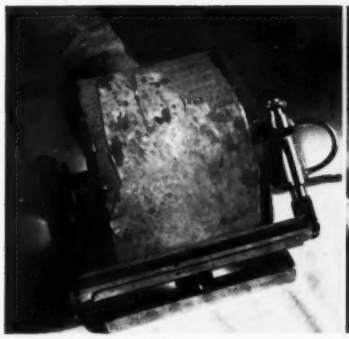

Fig. 3.

Fig. 4.

Fig. 1. Cadet C. H. Heavy, hypertrophic scarring of the dorsum of hands following 2d and 3d degree burns. Scars were throbbing, tender to palpation, and sensitive to weather changes. Minor injuries to the hands caused the scars to break down.

Fig. 2. Entire scar of left hand excised, including prolongations of scar up the fingers. The normal subcutaneous bed present under the scar is shown.

Fig. 3. The pattern of the area to be grafted, cut of hard faced sterile filter paper, is placed on the dermatome skin graft, 0.018 inch thick, with the skin side of the pattern in contact with the raw surface of the graft. If the pattern is turned over to place subcutaneous side against raw surface of the graft, the skin graft will be cut in reverse.

Fig. 4. The skin graft is cut along the outline of the pattern against the dermatome drum with a scalpel. The pattern adheres to the skin graft making it unnecessary to hold it in position against the graft.

cut around the pattern against the drum (Fig. 4). Excess areas of skin are removed from the drum until only the pattern graft remains. Small hemostats are placed on the edges of the graft, and it is peeled slowly away from the drum, during which time it is lightly dusted with sulfanilamide powder which neutralizes the stickiness of the cement remaining on the graft. Ordinarily, no sulfanilamide powder is used under the graft, although we have seen no untoward effects on healing from its use. The bandage is now carefully removed from the hand and further small bleeding points are caught and tied with fine silk. The graft is

Fig. 5.

Fig. 6.

Fig. 5. The pattern graft sutured in position with interrupted and continuous stitches of fine, black silk. The graft has been perforated and is ready for dressing. The exact fit of the skin graft to the defect is well shown.

Fig. 6. Graft at time of first dressing 10 days later. A complete take of skin has ensued. Two small superficial blisters may be seen.

transferred to the hand and sutured in various strategic points with interrupted fine silk stitches, following which a continuous suture may be used for the final approximation (Fig. 5). The graft is perforated and covered with a single layer of xeroform gauze followed by several wet gauze sponges smoothly laid over the graft and on top of which are placed marine sponges sufficiently large to cover the entire grafted area. The moist gauze sponges soak up any oozing which occurs during the early period of fixation of the graft. A light plaster cast is applied over the entire hand and forearm to immobilize the hand and fingers effectively. This dressing is permitted to remain 10 days, unless signs of infection beneath the graft are evident. At the end of this period of time, the sutures may be removed and the graft lightly dressed with a grease gauze preparation such as xeroform (Fig. 6). Motion of the fingers and hand should be restricted for another 10 days.

Cadet C. H. (Figs. 1–6), aged 22 years, received severe 2d and 3d degree burns of the hands, face, and legs in an airplane crash. The hands and face were treated with sulfathiazole ointment, and the burned areas of the legs débrided and tanned with tannic acid and silver nitrate. The patient was transferred to Lawson General Hospital for further care. The legs were treated by the application of split skin grafts following removal of the eschar and healed without event. The burns of the hands healed with the formation of a heavy hypertrophic scar along the dorsums. This scar was throbbing, tender to palpation, and sensitive to weather change. The cicatrix was excised from the right hand and a pattern dermatome graft 0.018 inch in thickness was sutured into position. Healing was uneventful and a satisfactory restoration of cutaneous covering was achieved.

Early grafting of the hands following a deep burn of this type would have minimized the length of the convalescent period and probably removed the necessity for future grafting. We seldom see patients in this early state, however.

Pfc. A. S., aged 24 years, received 2d and 3d degree burns of the face, neck, chest, and hands when he was sprayed with burning gasoline while on duty. The burned areas were treated with tannic acid and a number of pinch grafts were subsequently applied to the granulating areas of the chest and shoulder. The patient was eventually transferred to Lawson General Hospital for further care. On his admission here, the burned areas of the hands were completely healed; several small granulating areas were present on the chest and shoulder, intervening areas between the small deep grafts which had been previously applied. The entire dorsum of the right hand had healed with heavy, keloidal scar which extended up the arm, through the distal one-third, and was continuous along the fingers (Fig. 7). The left hand presented a heavy scar along the left thumb and wrist on both the dorsal and volar surface. The scars were so heavy as to interfere with effective hand and finger movements. Areas over the knuckles would crack and bleed following activity of the hands. The scar of the left hand was excised *in toto* and replaced with a pattern graft 0.018 inch in thickness, as described. Complete healing ensued. The right hand was reconstructed; approximately 50 square inches of skin was used to replace the scars of the wrist, hand, and the fingers. A satisfactory result was obtained (Figs. 8, 9). There is good function of the hand and scar formation about the borders of the graft is minimal.

We have utilized this technique for the covering of aseptic denuded areas in cases in which previously a full thickness skin graft would be utilized, or in which a large split skin graft would be sutured into the defect by overlaying the margins or trimming the periphery during suturing. The use of the pattern graft results in a finer ultimate scar juncture with the surrounding normal skin and is actually time saving in suturing the graft in position. For extensive reconstructions, as both hands,

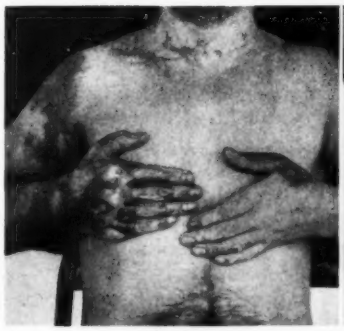

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 7. Pvt. A. S. Extensive burn scar of dorsum of right hand and wrist. The keloidal area of the left thumb and hand has been repaired with a pattern dermatome graft.

Fig. 8. Pvt. A. S. Repair of the left and right hands with two pattern grafts restoring approximately 50 square inches of skin to the right hand and forearm. Photographed 7 months after repair. Function and texture of grafted skin is excellent. It is more deeply pigmented than the adjoining skin.

Fig. 9. Pvt. A. S.

complete full thickness use is often prohibitive because of the large area of skin to be utilized, and on the dorsum of the hand is quite unnecessary as sufficient cutaneous protection may be obtained with the split graft.

On large palmar contractures, in which sufficient subcutaneous tissue remains, the scar is excised and replaced with a pattern, thick split skin graft. Subsequent contractures are corrected with small full thickness grafts. Smaller areas of cicatrix on the palmar surface are treated by the usual full thickness skin grafting technique. However, in extensive cicatrices, the large area to be covered by full thickness grafts makes the method almost prohibitive, particularly if other areas of the body remain to be reconstructed. We have, therefore, reserved the full thickness graft for the final stages of correction, relying principally on the pattern dermatome graft for the major reconstruction. This procedure has resulted in the provision of a good protective covering to the palm and a good ultimate functional result.

Sgt. J. F. R., aged 28 years, received severe 3d degree burns of the palmar surfaces of both hands,

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 10. Sgt. J. R. Burn contractures of the palms of right and left hands. With the exception of the 1st and 2d fingers of each hand, the digits are fixed by heavy scar.

Fig. 11. Sgt. J. R. The major correction has been accomplished with pattern dermatome grafts, 0.024 inch in thickness. Contractures along the suture line of each thumb remain to be corrected with small full thickness grafts. This patient forms keloids.

Fig. 12. Sgt. J. R. Illustrating satisfactory function of hands at the present time following restoration of the palmar surfaces with the application of pattern dermatome grafts.

and 2d degree burns of the forearms, while on duty. Before admission to Lawson General Hospital, he was treated by débridement of the burned areas and tannic acid and allowed to heal spontaneously following removal of the eschar. A very heavy hypertrophic scarring of both palmar surfaces extending along the flexor surfaces of certain fingers developed. Typical rigid claw hands without function developed and the patient was transferred to Lawson General Hospital for reconstruction, with all burned areas completely healed (Fig. 10). In several stages, the entire cicatrices of the right and left hands were excised in their entirety and the palmar surfaces were restored with pattern dermatome grafts 0.024 inch in thickness. Satisfactory healing and extension of the fingers followed these procedures. Subsequent contractures of the fingers and thumb were released by further excision of the scar juncture between graft and normal palmar skin and implantation of small full thickness skin grafts (Figs. 11, 12). At present fairly satisfactory function of the hands is present, although a few additional minor adjustments remain to be done. In this case, the use of thick dermatome pattern grafts simplified the placing of a complicated graft to the hand and at the same time provided excellent covering of the palmar fat which was approximately normal in extent. Whenever an area of skin is removed from this patient, keloids form thereby complicating his treatment.

Keloid formation is not a contraindication to skin grafting. On the contrary, we have noted, as have others, that there is no tendency for keloidal formation in the grafted area except at the suture line. This may be minimized by meticulous coaptation of the edges between skin and skin graft and perhaps early x-ray therapy to the suture line, although the efficacy of this medium has not always been impressive. The donor sites frequently exhibit keloid formation even from the thinner split grafts, and in areas where full thickness grafts of skin have been removed, heavy keloidal scars usually develop. It is therefore desirable to remove skin for grafting from areas in which the functional or cosmetic after effects are of no significance.

It is realized that if insufficient palmar fat remains so that palmar fascia or tendons are exposed after excision of the cicatrix, it is necessary to provide a fatty pad in addition to the skin covering for the achievement of a satisfactory result. This may be accomplished by the use of a pedicle flap from the abdomen or other accessible site. Because of the detailed steps in reconstruction occasioned by the use of a pedicle flap, this is not the method of choice in the repair of hand injuries. It remains one of necessity. In addition, the pedicle flap provides a thick bulky reconstruction which does not simulate the normal covering of the hand as closely as does the free transplant placed on the natural subcutaneous fat bed. This additional thickness may be reduced by subcutaneous thinning procedures, but adds to the length of hospitalization and convalescence.

SUMMARY

A method of utilizing the dermatome to provide a pattern graft has been developed, and the uses of the dermatome pattern graft in the repair of cutaneous injuries of the hands is described. This procedure consists in the removal of a split graft with the dermatome, cutting a pattern of the area to be grafted and transferring the pattern to the dermatome drum where the outline is cut on the drum. The graft is subsequently transferred to the recipient area where it is sutured and dressed in the customary manner. The method thus described represents a combination of full thickness and split thickness grafting technique, and is especially suitable for the grafting of large areas of irregular outline. Since the donor site requires no additional surgery for closure as does the full thickness grafting technique, this procedure simplifies the problem of restoring areas of considerable size and complicated design. The advantage of treating keloidal areas by complete excision and skin grafting by this method is mentioned. Several cases illustrating the use of this method in the repair of cutaneous injuries to the hands are presented.

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ESOPHAGOBRONCHIAL FISTULA

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FISTULAS between the food passages and the tracheobronchial tree have been classified into four main groups. A study by Monserrat of reported cases in the world literature revealed 222 congenital, 367 neoplastic, 41 infectious, and 40 traumatic fistulas. These figures probably represent but a small proportion of the total number, particularly of the congenital and neoplastic groups since these commonly terminate fatally and many never are recorded in the literature. Infectious and traumatic forms, although few in number, offer a better prognosis and from this standpoint alone are of greater interest medically.

Cases due to trauma are commonly caused by swallowed irregular or pointed foreign bodies, such as bones. The trachea or left main bronchus should be more commonly involved because of their close proximity to the esophagus. The case reported by Murtagh and Tyson affords a classical example. Although there was a history of swallowing a foreign body, roentgen-ray studies of the swallowing function were negative. The subsequent development of cough when swallowing fluids and the demonstration by roentgen-ray examination of swallowed barium entering the left main bronchus established the diagnosis of esophagobronchial fistula. At esophagoscopy no foreign body was found although an area of ulceration and inflammation was observed. Gastrostomy was performed, and at a subsequent esophagoscopy a bone was found and removed. The fistula healed promptly and the patient made a satisfactory recovery. It is not always possible to elicit a foreign body history or find a foreign body esophagoscopically so that a sharp distinction between traumatic and infectious cases cannot always be made.

Infectious cases may be of syphilitic, tuberculous, or nonspecific origin. A case of tracheoesophageal fistula of syphilitic origin observed at the clinic was reported by Bucher and Ono. Monserrat reported 3 cases of tuberculous origin. This more often occurs in children and apparently is the result of the breaking down of a tuberculous lymph node. The origin of fistula in adults is not entirely clear. In a case previously reported (2) there was a communication between the esophagus and left lower lobe bronchus apparently of 7 years' duration. There was no history of foreign body, syphilis, or tuberculosis, in fact the only abnormal findings noted were cough when taking liquids and the presence of a chronic pulmonary suppuration involving the lower lobe of the left lung. In this case the esophageal end of the fistula was cauterized with silver nitrate and apparently closed for a time only to recur later. External surgical treatment was carried out, but the patient died from a bronchopulmonary complication.

Two additional cases of esophagobronchial fistula have been observed at the bronchoscopic clinic, Jefferson Hospital. These are of interest because of the cause, duration, clinical course, and measures employed in obliterating the esophageal end of the fistula.

CASE 1. Mrs. R., aged 61 years, was admitted to the clinic during January, 1941, with a diagnosis of bronchoesophageal fistula which had been made elsewhere during April, 1940.

The family and personal medical history was negative. During January, 1940, she was admitted to the Letterman General Hospital for study. There was a history of nonproductive cough, mild digestive disturbances, and slight fever of about 2 weeks' duration. The cough later became productive and there was some hemoptysis. A diagnosis of pulmonary abscess involving the middle lobe of the right lung was made and this was treated by medical measures including bronchoscopic drainage. While convalescing from the pulmonary infection it was noted during April, 1940, that there often were paroxysms of coughing associated with drinking fluids, particularly water. This difficulty became progressively worse, and at one time the patient had a severe strangling attack after swallowing solid food. A fluoroscopic study of the swallowing

Fig. 1. Roentgenograms made after patient swallowed a small quantity of iodized oil revealed a shadow extending from the wall of the esophagus into the right lung field. Subsequent studies with barium in larger quantity revealed a large quantity of barium in the right bronchus.

function after the administration of barium, demonstrated the opaque material entering the right bronchus. A diagnosis of esophagobronchial fistula was made and gastrostomy was performed. Cough continued to be troublesome and there was some sputum, at times foul. During the latter part of May, 1940, a mass of dark necrotic material, which exhibited the appearances of a necrotic lymph node, was coughed up. Following this there was definite improvement in the bronchopulmonary symptoms, but she still was unable to take foods or fluids by mouth without inducing severe cough. Swallowed mouth secretions also were frequently coughed up, and occasionally these were blood tinged.

On admission to clinic in January, 1941, patient's general condition appeared satisfactory. A gastrostomy tube was *in situ*. She was unable to take foods or fluid without coughing. She had to lie on left side or with shoulders elevated when recumbent to avoid paroxysms of cough.

At esophagoscopy there was found a small elliptical depression on the anterior and right lateral wall of the esophagus, 30 centimeters from the upper teeth. The surrounding mucosa appeared normal. Palpation with a small flexible tube revealed that this could be passed about 1 centimeter beyond the bottom of the small depression. Bronchoscopy revealed moderate inflammation of the mucosa of the right main bronchus extending to the middle lobe bronchial orifice. Esophagoscopy was performed with fluoroscopic assistance and iodized oil was instilled into the depression on the right lateral wall of the esophagus. A few drops of oil were seen to pass to the right of the esophagus in the neighborhood of the right main bronchus, but it was not possible to localize this accurately with relation to the bronchial tree because of the small quantity used. Thin barium mixture then was swallowed and a considerable quantity was seen to emerge from the right side of the esophagus several centimeters below the carina (Fig. 1). Immediately upon making this observation the patient had a severe paroxysm of coughing and it was apparent that a considerable quantity of barium had entered right bronchus as a thin coating could be observed along its walls.

In view of previous unsatisfactory experiences with silver nitrate as a sclerosing agent it was decided to employ a 25 per cent acid acriflavine solution to obliterate the fistula, and swabs saturated with this were applied for a total of 6 minutes. Three additional applications were made at intervals of 2 weeks. While there was definite subjective improvement observed, since the patient could now lie on the right side without provoking cough, the fistula still remained patent. Following this, silver nitrate in 25 per cent and later 50 per cent solution was applied on 2 occasions but with no apparent obliteration of the fistula. It was then concluded that sodium hydroxide would probably give better re-

Fig. 2. Roentgenogram made after patient swallowed a quantity of barium revealed considerable in the right bronchus and also showed a definite communication between the right wall of the esophagus and the right bronchus. This promptly induced coughing and a more general distribution of the barium which, however, disappeared from the bronchial tree within 24 hours.

sults in view of its excellent sclerosing effects in the esophagus when swallowed accidently. Crystals of sodium hydroxide were fused on a metal applicator bent slightly at its distal end, and this was introduced into the esophageal end of the fistula and retained in place for 3 minutes. Another application was made in 3 weeks. Four weeks later the patient was examined esophagoscopically and by roentgen-ray study. There was noted considerable scarring of the esophageal wall at the site of the fistula but nothing could be found to suggest any communication or opening. A roentgen-ray study of the esophagus with a thin barium mixture revealed no evidence of communication between the esophagus and bronchus. The patient was allowed to take foods by mouth and had no difficulty. There were no respiratory symptoms. The gastrostomy tube was removed about 4 weeks later and the fistula closed.

The patient has been free from all symptoms for over 18 months.

CASE 2. Mr. L., aged 60 years, was admitted to the clinic during May, 1941. His complaints were inability to take any liquid foods by mouth or to sleep on his right side for a period of 32 months. The family and personal medical history was negative. During July, 1938, he developed what was considered a mild attack of grippe. During the latter part of the illness, which lasted about 2 weeks, it was noticed that paroxysms of coughing occurred when taking liquid food, particularly water. This became very troublesome and his physician instituted feeding by tube. Because of the persistence of cough when food was taken a roentgen-ray study of the swallowing function was made. This revealed a large esophagobronchial fistula, the communication being between the esophagus and the right main bronchus. Gastrostomy was recommended, but the patient preferred to continue with feeding by tube since he had no difficulty with passing it and had become accustomed to taking liquid feedings and water several times daily. Solid foods caused little distress but liquids could not be swallowed without provoking severe paroxysms of cough.

When admitted to the clinic during May, 1941, he had taken liquid foods and water by tube for 32 months. He could not lie on right side and often was awakened on changing posture. He had slight cough apparently due to swallowing mouth secretions which passed from esophagus into right bronchus.

Roentgen examination of the swallowing function on May 17, 1941, revealed a large esophagobronchial fistula the diameter of which was approximately 5 millimeters (Fig. 2). When using thin barium mixture a considerable quantity was observed to flow into the right bronchus. At esophagoscopy there was a small depression on right lateral wall of the esophagus 31 centimeters from upper teeth. A small flexible tipped aspirating tube was passed without difficulty into fistula a distance of 3 centimeters.

Bronchoscopic examination revealed marked inflammation and edema of the mucosa of the right bronchus extending down to the orifice of the middle lobe orifice. A small opening approximately 2 millimeters in diameter was observed along the inner wall of the bronchus, and frothy secretion was seen coming from this. A flexible tipped tube could be passed into the bronchial end of the fistula for a distance of about 2 centimeters.

Having observed the beneficial effects of sodium hydroxide as a cauterizing agent in the previous case we proceeded with this method of treatment. A bead of sodium hydroxide crystals fused on the tip of a small flexible aspirating tube was carried into the esophageal end of the fistula and allowed to remain for 3 minutes. When observed 3 weeks later the patient stated that he had relatively little cough and had gained 8 pounds in weight. At esophagoscopy the small pouch previously observed was the seat of marked inflammatory changes, but no definite communication could be noted. Additional sodium hydroxide crystals were applied and allowed to remain for 2 minutes. The patient was observed 5 weeks later. He was then able to take liquids by mouth without distress and could lie on his right side without exciting paroxysms of coughing. There were no respiratory symptoms. Esophagoscopic examination revealed a small pouch on the right lateral wall of the esophagus, but there was no ulceration nor could any communication be demonstrated. A roentgen-ray study of the swallowing function revealed no evidence of barium entering the bronchus; the esophageal outline itself appeared normal.

Patient has no disturbances in swallowing, subsists on normal diet and has exhibited no symptoms since last esophagoscopic treatment 1½ years ago.

SUMMARY

Two patients with esophagobronchial fistula between the right main bronchus and esophagus which existed for 9 and 32 months, respectively, are reported. No definite cause could be demonstrated although one patient had developed a pulmonary abscess and coughed up a mass of necrotic tissue immediately preceding the development of symptoms. There was no apparent tendency for the fistula to close after the esophagus was placed at rest. Prompt closure of the esophageal end of the fistula resulted following the esophagoscopic application of sodium hydroxide crystal fused on a curved metal applicator and carried into the fistula for a distance of several centimeters. Both patients have been free from symptoms over 18 months.

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FACE AND PERSISTENT BROW PRESENTATIONS

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IN this paper an analysis is given of 87 face and 13 persistent brow presentations which occurred at Harlem Hospital, New York, between January 1, 1914, and June 30, 1942. The results obtained and the conclusions drawn from them are compared with accepted views regarding this problem. For the years 1914 through 1929 departmental summaries rather than official bedside records were used. As the departmental summaries were not complete in all respects, the cases of these earlier years are analyzed only if reliable data are available.

INCIDENCE

Among the 46,058 deliveries at Harlem Hospital during the interval mentioned there were 87 face and 13 persistent brow presentations. Thus there was 1 face presentation in 529 deliveries, or 0.19 per cent; 1 persistent brow presentation in 3,543 deliveries, or 0.03 per cent; and a combined ratio of 1 in 461 deliveries, or 0.22 per cent. The ratio of face to persistent brow presentations was 6.7 to 1, which compares to most series.

However, the absolute incidence of 1 face presentation in 529 deliveries compares favorably only with the ratios of Tweedy and Schumann of 1 in 587 and 1 in 400, respectively, and is in contrast with the accepted figure of 1 in 200, which is probably taken from Pinard's series of 90,000 cases in 1889 and from Markoe's series of 60,000 cases in 1909.

Our incidence of 1 persistent brow presentation in 3,543 deliveries is not far removed from the 1 in 3,000 found by DeLee (1), but differs greatly from the usually cited figure of 1 in 1,500 to 2,000 cases (18).

ETIOLOGY

In this series, the records of 79 cases were complete for a consideration of etiology. In 46 cases, or 58.2 per cent, 1 or 2 of the 16 known predisposing factors—exclusive of multiparity—were present, 2 being found in 5 of these cases and a single factor in 41. None of these causes were operative in the remaining 33 cases, or 41.8 per cent.

The number of cases in which these factors were found, either alone or in combination, was:

		Cases
1. Contracted pelvis		15
2. Large child		14
8½ to 10 pounds	11	
10 pounds and over	3	
3. Coils of cord around the neck		7
4. Fetal monstrosity		5
Anencephaly	3	
Dolichocephaly	1	
Meningocele	1	
5. Hydramnios		4
6. Abnormal implantation		4
Placenta previa	2	
Low implantation	2	
7. External version[1]		2
8. Combinations of the above factors		5
Hydramnios and large child	2	
Hydramnios and contracted pelvis	1	
Cord around neck and large child	1	
Placenta previa and large child	1	

Disproportion was thus present in almost 2 of every 3 cases, or 63.5 per cent, in which some etiologic factor was recorded.

Other predisposing factors often mentioned, but not found in this series, are: cystic tumors of the neck (hygromas) and thyroid tumors, intervention of the arms between the chin and sternum, spastic contraction or congenital shortening of the neck muscles, marked enlargement of the neck or thorax, constriction of the cervix around the neck of the fetus, and fibroids. With the exception of coils of cord around the neck, all of these and the afore-

[1]The other serious complication the authors have found to follow this maneuver is premature separation of the placenta. If, however, external version is done, the following rule should be followed: If the fetal back is to the mother's left, rotation should be clockwise; if the fetal back is to the mother's right, rotation should be counterclockwise. This allows the chin to follow the occiput and thus favors flexion of the head. If the chin were the leading pole, meeting the soft tissue resistance, extension would be favored.

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mentioned predisposing causes may be diagnosed roentgenographically.

All of these conditions either interfere with flexion, favor extension, or obstruct descent. It is stated that these factors come into play only after the onset of labor, changing an original occiput or brow to a face (secondary face presentation); primary face presentation is supposedly rare. However, since the completion of this series, we observed a case in which roentgenography proved an unengaged face presentation when the patient was not in labor. Sixteen hours later, another roentgenogram taken a few hours before the onset of labor showed an engaged vertex presentation.

One patient in this series, a quintipara, had three face presentations.

The predisposing factor of multiparity is shown in the following classification, which groups 86 cases according to parity: 24 nulliparas, 18 primiparas, 28 with second to fourth child, 15 with five or more children, and 1 unclassified.

Half of these patients, 43, had had at least two previous term deliveries of living children. Sixty-two, or 72.1 per cent, were multiparas, as contrasted with 58 per cent multiparas in all deliveries on our service. This deviation of 14.1 per cent is statistically significant.

Twelve of the entire 100 patients, or 12 per cent, gave birth to premature children. Only 10.3 per cent of the face presentations, but 23 per cent of the persistent brows were premature, as compared with 10 per cent prematures among the entire service.

The average birth weight of 64 full term children was 7 pounds, 12.2 ounces. This contrasts with 7 pounds, 2 ounces, the average birth weight of full term children at Harlem Hospital. Eleven of the 64 children weighed over 8½ pounds; of these, 3 weighed 10 pounds or more.

MECHANISM

It should be noted that the criterion for engagement of vertex presentations, namely, that the lowermost point be at the level of the ischial spines, is not true for face presentations, as the distance from the parietal eminences to the face is greater than to the occiput. Thus the face must descend considerably below the level of the ischial spines before we may conclude that the trachelobregmatic and biparietal diameters have passed the superior strait.

The mechanism of both anterior and posterior mentum presentations is analogous to that of vertex presentations, with the mentum instead of the occiput as the point of reference.

Three possible abnormalities in this mechanism were first described by Hirst:

1. Internal rotation may be delayed, due to mechanical difficulty, as the chin must descend to a lower level before meeting the necessary soft tissue resistance. The fetal neck must stretch, as its length is normally less than one-half the depth of the anterior pelvis.
2. Delivery is mechanically impossible with posterior rotation of the chin to the hollow of the sacrum when the depth of the pelvis is 30 per cent greater than anteriorly.
3. Posteriorly displaced arms into the cavity of the extended back of the fetus greatly impede its progress.

Molding occurs with the usual shortening of the engaging diameter, here the trachelobregmatic, with compensatory lengthening of the directional diameter, the occipitofrontal. The caput succedaneum occurs over most of the face (or forehead in a brow) and is pronounced, especially in posterior mentum presentations.

Almost 2 of 3, or 64.4 per cent, of all face presentations in this series delivered spontaneously. More than 3 of 4 cases, or 76.4 per cent, recorded as mentum anterior or transverse delivered spontaneously, while more than 1 of every 3, or 35 per cent, diagnosed as posterior mentum presentations were spontaneous deliveries.

The mechanism of a persistent brow presentation is analogous to that of an occiput posterior delivery as such, i.e., "sunny side up," with the root of the nose stemming under the symphysis. Since a wider circumference presents and engages in a brow presentation, spontaneous delivery is not the rule, except with a small fetus or a great uterine force. Much molding must occur before even engagement. The engaging diameter (the occipitomental) is diminished, while the directional diameter increases. Because of the extensive

TABLE I.—POSITION OF FETUS AT TIME OF DIAGNOSIS IN FACE AND PERSISTENT BROW PRESENTATIONS

A. Face presentations	Point of reference			Total
	Right	Left	Not stated	
Mentum anterior	17	25	2	44
Mentum transverse	6	5	0	11
Mentum posterior	16	3	1	20
Total face presentations	39	33	3	75*
B. Brow presentations				
Sinciput anterior	0	5	0	5
Sinciput transverse	2	1	0	3
Sinciput posterior	0	0	1	1
Total brow presentations	2	6	1	9*

*In addition, there were 12 face and 4 brow presentations, recorded simply as "face" and "brow," respectively, bringing the grand totals to 87 face and 13 persistent brow presentations (100 cases).

prerequisite molding, dystocia is common; and because of the necessarily great uterine force, deep perineal lacerations usually result. However, flexion to a vertex or extension to a face usually takes place.

In this series, there were only three babies, all of them small, who were delivered spontaneously.

The incidence of the various positions as recorded at the time of diagnosis is shown in Table I, from which it will be seen that the ratio of face to brow presentations was 87 to 13, or 6.7 to 1. The point of reference, which was given in 80 cases, was on the right in 41 (39 face and 2 brow), on the left in 39 (33 face and 6 brow), and not recorded in the remainder. At the time of diagnosis, the trachelobregmatic diameter lay in the right oblique of the pelvis in 46 cases, in the left oblique in 20, in the transverse of the pelvis in 14 and was unclassified in 20.

CLINICAL COURSE

The first stage of labor is definitely prolonged. In this series, the average duration for anterior and transverse mentum cases at term was 23 hours, 8 minutes, for primiparas and 21 hours, 20 minutes, for multiparas; and for posterior mentum cases, 36 hours, 5 minutes, for primiparas and 31 hours, 5 minutes, for multiparas. These figures contrast with the accepted average duration of the first stage in vertex presentations, which is 16 hours for primiparas and 12 hours for multiparas.

The factors prolonging the first stage are generally believed to be: the nonmolding of the face bones, which are feeble dilators; the dissipation of some of the uterine force in the wrong direction, due to the angle between the head and neck; and the delay in internal rotation resulting from the necessity of the chin's descending to a lower level before meeting sufficient soft tissue resistance.

The membranes tend to rupture early. Among 47 cases, they ruptured before or in early labor in 21 cases, just before or at the onset of the second stage in 11, and well into the second stage in 15. The average time for rupture of the membranes in vertex presentations is believed to be at the onset of the second stage.

Among full term deliveries it was interesting to observe that in 9 cases (7 anterior or transverse and 2 posterior mentum) in which the membranes ruptured before or soon after the onset of labor, the average duration of the first stage was 26 hours, 26 minutes. In 6 cases (5 anterior or transverse and 1 posterior mentum) in which rupture took place in the mid-first stage, the duration was 22 hours, 30 minutes. In 15 cases in which the membranes broke in the second or late first stage, the average duration of the first stage was 19 hours, 55 minutes.

Although the cases here cited are not sufficient for statistical proof, they do indicate a tendency toward early rupture of the membranes, which, contrary to its effect in vertex presentations, is probably a factor in the prolongation of the first stage in face presentations.

DIAGNOSIS

The classical criteria for the diagnosis of face and brow presentations are usually given as follows:

A. Before labor, on abdominal palpation. 1. The cephalic prominence is marked on the same side as the dorsum in a face, while equally palpable on both sides in a brow, presentation.

2. The presenting part is high. In brow presentations an unusually large mass of head is felt above the pelvis.

3. A large groove is felt between the back and the occiput.

4. The dorsum is concave and is felt distinctly only in the neighborhood of the breech.

5. The fetal small parts are unusually easy to palpate, especially in anterior positions of the presenting part.

6. DeLee's "triangular area" is not felt.

7. The fetal heart sounds are loud and are heard below the umbilicus and usually on the same side as the fetal limbs.

8. The uterine ovoid is unusually longitudinal and long.

In reviewing the cases in this series and in drawing from their own experience, the authors were impressed by the difficulty of diagnosis solely on abdominal palpation, and especially by the inconsistency of the position of the cephalic prominence in relation to the dorsum. The most reliable of the above criteria was the unusually long and longitudinal ovoid shape of the uterus.

B. Early after the onset of labor. Diagnosis is supposedly easy on vaginal or rectal examination within a short time after the rupture of the membranes. The characteristic landmarks are the orbits, the mouth and gums (the anal orifice grips the examining finger), and the nares.

In this series a fair degree of success was achieved in diagnosis at this stage.

C. Late in labor. If several hours have passed since the membranes have ruptured, the large caput succedaneum so modifies the face that it may be mistaken for a breech. The examiner feels an irregular surface, with prominences and depressions, unlike a vertex. The distinguishing features are the saddle of the nose and the mouth and gums; as has been noted, the anus grips the finger.

The time and means of diagnosis in 54 cases in this series are given in Table II. In this table, the roentgen-ray diagnoses, but not the confirmations, are included in the totals. Only 2 cases, or 3.8 per cent, were suspected on abdominal palpation, while 17 cases, one-third, were diagnosed or suspected on rectal or vaginal examination during the first stage.

TABLE II.—TIME AND MEANS OF DIAGNOSIS OF 54 CASES OF FACE AND PERSISTENT BROW PRESENTATIONS

Means	Time				
	Before onset of labor	First stage	Second stage	On delivery table	Presenting part at vulva or on delivery
Suspected on abdominal	1	1			
Rectal		11	5		
Vaginal		6	6	4	16
Roentgen ray					
Confirmation	1	5			
Diagnosis		4			
Total Time of suspicion	1*	22*	11	4	16

*Roentgen ray diagnoses, but not confirmations, are included in the totals.

Thirty-four cases, or 62 per cent, were diagnosed before the patient was placed on the delivery table. One case, which was not recognized until spontaneous delivery, had been diagnosed as a breech on vaginal examination during the first stage.

PROGNOSIS

A. Maternal. A less favorable maternal prognosis in face and brow than in vertex presentations may be expected for the following reasons: (1) Longer duration of labor; (2) greater frequency of perineal tears: Protrusion and stretching of the perineum occur because of the increased depth to which the presenting part, the chin, must descend before it may impinge against the maternal symphysis; (3) greater danger of infection; (4) frequency of necessary and unnecessary interference.

Thus, while maternal mortality is less than 1 per cent in vertex presentations, it may rise to as high as 6 per cent in face presentations. In this entire series of 100 cases, there were 3 deaths, or a mortality rate of 3.0 per cent. This figure includes 1 death among 87 face presentations (a mortality rate of 1.15 per cent, or 159 deaths per 10,000 live births), and 2 deaths among 13 persistent brow presentations (a rate of 15.4 per cent, or 2222 deaths per 10,000 live births), contrasted with

TABLE III.—MANAGEMENT OF 100 CASES OF FACE AND PERSISTENT BROW PRESENTATIONS

Management	Results							
	Full term				Premature		Total births	Maternal deaths
	Live births	Stillbirths or neonatal deaths	Craniotomies	Monsters	Live births	Stillbirths or neonatal deaths		
A. Face								
Spontaneous	42	6	0	3	3	2	56	1
Version	12	4	2	0	1	0	19	0
Cesarean	5	0	0	0	0	0	5	0
Kielland	2	1	0	0	0	0	3	0
Manual rotation plus DeWees	0	0	0	1	0	0	1	0
Simpson	0	1	0	0	0	0	1	0
DeWees	0	1	0	0	0	0	1	0
Rotation with DeLee	0	0	0	0	0	1	1	0
Total face presentations	61	13	2	4	4	3	87	1
B. Brow								
Spontaneous	1	0	0	1	0	1	3	0
Version	5	1	1	0	0	0	7	1
Cesarean	1	0	0	0	1	0	2	1
Kielland	1	0	0	0	0	0	1	0
Total brow presentations	8	1	1	1	1	1	13	2
Total	69	14	3	5	5	4	100	3

a maternal mortality rate of 1.1 per cent, or 131 deaths per 10,000 live births for the entire service in 1932 (10).

One fatal case occurred in 1928 from a ruptured uterus following a version on a right sinciput transverse complicated by a Bandl's contraction ring; delivery was concluded with a craniotomy and manual removal of the placenta. Another death had taken place in 1922 in an eclamptic with the fetus in the right mentum anterior position; labor was induced and resulted in a stillbirth; the mother died of lobar pneumonia. The third death, in 1933, was that of an 18 year old primipara with pre-eclampsia and a conjugata vera equal to 8.5 centimeters; the fetus was in the left sinciput anterior position. Thirty-five hours after the onset of labor and 2 hours after the rupture of the membranes, a cesarean section with peritoneal exclusion was performed. Death occurred 5 days later from staphylococcus septicemia. The postmortem examination revealed generalized peritonitis with intestinal obstruction, cloudy swelling of the spleen, liver and kidneys, and a postpartum uterus.

This series did not show so large a percentage of lacerations or infections as might have been expected. There were recorded 1 cervical laceration into the left fornix, 11 episiotomies, 8 second degree lacerations and 8 first degree lacerations. Some type of infection was observed in 13 cases; 1 of these was a generalized peritonitis resulting in death, and 2 were lobar pneumonia, of which 1 was fatal.

B. Infant. The following explanations have been offered for the increased infant mortality in face and persistent brow presentations: (1) delayed labor with dystocia, especially in persistent brow presentations; (2) cerebral compression; (3) compression of the neck against the pubis, which interferes with the return circulation from the head; (4) great elongation of the neck in posterior mentum positions before the chin can reach the level necessary for rotation; (5) compression of the trachea and larynx against the

TABLE IV.—RESULTS OF 84 CASES OF FACE AND PERSISTENT BROW PRESENTATIONS ACCORDING TO PARITY

	Full term						Premature		Total
	Normal live births		Stillbirths or neonatal deaths		Monsters	Normal live births	Stillbirths or neonatal deaths	Monsters	
	Vaginal delivery	Cesarean section	Vaginal delivery	Cesarean section					
Primiparas	12	4	3	0	1	1	1	3	25
Multiparas	42	1	9	0	1	4	2	0	59
Total	54	5	12	0	2	5	3	3	84

pubis with suffocation or even rupture; (6) injury from the use of forceps or other operative procedures; (7) trauma to the eyes by careless vaginal examination; (8) impaction in posterior positions if the chin rotates to the hollow of the sacrum: A live child cannot be delivered from below.

In Table III the results of the 100 cases in this series may be seen. The corrected total infant mortality is defined as the percentage of nondeformed children born at term that were either stillbirths or neonatal deaths within 10 days. The corrected immediate infant mortality is defined identically, except that it excludes neonatal deaths. Thus in this series the corrected total infant mortality was 17 of 86, or 19.8 per cent; for face presentations alone it was 15 of 76, or 19.6 per cent; for persistent brow presentations alone it was 2 of 10, or 20 per cent. The corrected immediate infant mortality for face presentations was 13 of 74, or 17.6 per cent. The usually quoted infant mortality rate for face presentations is about 14 per cent (4), although Markoe found as high as 20 per cent. For persistent brow presentations Irving reports an infant mortality rate of 50 per cent.

In our series, one fracture of the left humerus after a version was recorded.

For posterior mentum presentations, a maternal mortality of 0 per cent was accompanied by a corrected total infant mortality of 16.7 per cent, but only 15.8 per cent for the uncorrected infant mortality rate. These figures are even less than our total corrected infant mortality for all face presentations (18.3 per cent). However, the deviation is not statistically significant, as it is a chance variation. These statistics contrast strongly with Reed's findings of an infant mortality rate of 40.6 per cent for posterior mentum presentations and a corresponding maternal mortality of 11.6 per cent.

Five of 100, or 5.0 per cent, of all the cases were monsters, a predisposing factor (anencephaly, meningocele, etc.). They comprised 25 per cent of the premature deliveries (3 of 12), but only 2.3 per cent of the full term deliveries (2 of 88); they were 4.6 per cent of the face and 7.7 per cent of the persistent brow deliveries.

The results of 84 cases according to parity are given in Table IV, which shows that there was a 20 per cent infant mortality among the primiparas delivering nondeformed full term children vaginally, and a 17.6 per cent infant mortality among the corresponding group of multiparas. Due to the small number of cases the deviation is not statistically significant.

TREATMENT

The usually accepted principles regarding the management of and the techniques employed in face and persistent brow presentations may be summarized as follows:

A. Ceneral Principles of Management

1. Mentum anterior and transverse. Most authorities believe that since anterior and transverse mentum presentations all rotate anteriorly, the management of such cases, if recognized early, should be watchful waiting, except of course with a contracted pelvis. We follow the maxim, "If a 'face' is making progress, leave it alone." The high incidence of spontaneous delivery in this series attests to the wisdom of this policy. However, because of the increased maternal and infant

mortality and morbidity and the higher incidence of disproportion and prolonged labor with dystocia and its consequent dangers attached to all face presentations, the authors believe that in cases recognized early, especially in primiparas, cesarean section should be given greater consideration than heretofore. The exceptions with a dead or deformed child are obvious.

If a policy of watchful waiting is adopted, then follow all measures which will preserve the bag of waters, namely: (1) Have the patient lie on her side and abstain from all bearing-down efforts; (2) exercise care during vaginal and rectal examinations; (3) some have found it helpful to put a moderately filled bag into the vagina. We have not.

If the head is in transition from vertex to face, the patient lies on the side to which the occiput points, as this position favors extension. If the face is fully formed, the patient lies on the side to which the chin points, in order to facilitate descent and anterior rotation.

2. *Mentum posterior.* Before labor, deliver by cesarean section. Some authorities prefer to attempt to alter the attitude by Schatz's abdominal maneuver.

After the onset of labor, with the head engaged (1) if the cervix is undilated and the maternal and fetal condition good, consider cesarean section, especially if the membranes have ruptured; (2) if the cervix is two fingers dilated and the membranes intact or recently ruptured, conversion to occiput anterior is feasible by Ziegenspeck's vaginal maneuver plus Schatz's abdominal maneuver; (3) if the cervix is fully dilated and the membranes intact or recently ruptured (a) employ conversion to occiput anterior by DeLee's method or by the combined vaginal maneuver of Thorn plus Schatz's abdominal maneuver; or (b) try internal podalic version; most men prefer to attempt conversion first, while others give priority to version; (4) if the cervix is fully dilated and the above maneuvers (conversion or version) have failed, or if the obstetrician is of the opinion that too much time has elapsed since the rupture of the membranes, he may attempt manual rotation to an anterior mentum.

After the cervix is fully dilated, if the head is engaged, the authors prefer to employ Kielland forceps with subsequent rotation and delivery; their technique will be described. Other possibilities which have been suggested at this stage are cesarean section and conversion or manual rotation under deep anesthesia after the head has been pushed out of the pelvis.

If the head rotates to the hollow of the sacrum, most authorities advise pubiotomy or craniotomy, depending on the condition of the mother or child. In one case reported by Mussio and Walker in which such impaction occurred, the child was successfully delivered by Waters' extraperitoneal cesarean section, which these writers believe is especially adapted for delivery of the hyperextended occiput.

3. *Brow presentations.* Early: Although the factors which have resulted in the deflexion of the occiput to a brow are still present, and although with this conversion the vector of the transmitted uterine force shifts anteriorly in relation to the anteroposterior diameter, thus shortening the frontal and lengthening the occipital lever arm, all of which tends toward further deflexion, yet clinically most of these early brow presentations spontaneously flex back to an occiput with descent under the power of the uterine force. The remaining, as a rule, extend to face presentations. Few remain as persistent brow presentations. Thus the high fetal and maternal mortality rates for persistent brow presentations are greatly decreased for all early brow presentations. For this reason the authors do not advocate cesarean section in brow presentations early in labor, unless otherwise indicated. Instead they advise the following: (1) It is best to employ watchful waiting for brow presentations recognized early and to attempt postural conversion to a vertex: (a) have the patient lie on the side to which the occiput points, (b) apply a firm abdominal binder with a pad near the occiput. (2) The exception is the instance in which it is preferable to convert to and retain a vertex with Willett's forceps or even a tenaculum until engagement or further dilation of the cervix.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Primary face presentation. Anterior posterior view taken 18 hours before onset of labor. Left mentum transverse. Note extension of head and spine.

Fig. 2. Primary face presentation. Lateral view taken 18 hours before onset of labor. Left mentum transverse. Note again the marked extension of the spine and head.

Fig. 3. Spontaneous conversion of face to vertex. Same case 3 hours before onset of labor. Right occiput transverse. Note the well flexed head and spine. This spontaneous conversion is the reversal of the rule.

Late first or early second stage: (1) Flex to occiput; (2) If this fails, try internal podalic version.

Late second stage: Because of the great delay and dystocia, forceps are necessary when a brow presentation is unrecognized until this stage.

Fetus impacted in pelvis: This occurs when spontaneous delivery is attempted with a very small head. Piper (8) suggests pushing the head out of the pelvis under deep anesthesia, after lubrication with green soap, and following with internal podalic version.

The classification of the results of the 100 cases according to their treatment is shown in Table III. The following observations may be made:

1. Among face presentations, cesarean section produced the best results, with no fetal or maternal deaths in 5 cases.

2. Among the 4 cases of both face and brow presentation in which Kielland forceps were applied, there were no maternal deaths and only one fetal death, in spite of the fact that these must have progressed well into the second stage before interference.

3. Of the 3 persistent brow presentations which delivered spontaneously, one was a monster, one a premature stillbirth, and the third a full term living child.

4. Among the 26 cases in which internal podalic version was performed, there were one maternal death and 8 fetal deaths, all among full term children; 3 of the deaths were the result of craniotomy.

5. Almost one-half of the posterior mentum presentations were delivered by internal podalic version; this group comprised three-quarters of the cases in which interference was deemed necessary.

6. One manual rotation was succeeded by version.

7. One unsuccessful external conversion (probably by Schatz's maneuver) was followed by cesarean section.

8. Internal conversion of a posterior mentum to an occiput anterior (probably by Thorn's maneuver) was unsuccessful in 3 cases and was followed in all by successful internal podalic version.

These apparently difficult maneuvers have been mastered by some, however. In a series of 9 posterior mentum presentations reported by Mussio and Walker, one successful Schatz maneuver before labor was followed by a spontaneous occiput delivery 2 weeks later. Thorn's maneuver was successful in 4 of 6 attempts, resulting in 3 spontaneous occiput anterior and one mid-forceps delivery; all the infants survived. One Ziegenspeck maneuver resulted in a brow presentation. DeLee (2), using his modified technique of conversion, consisting of four steps, claims 23 successful attempts among 25 face presentations and 2 successful attempts among 3 brow presentations.

Fig. 4. Face presentation, right mentum posterior.

B. Techniques

The various techniques commonly employed are well described in most textbooks, especially the method of conversion, which may also be referred to in the original papers by Schatz, Thorn, and Ziegenspeck and in DeLee's (2) book for his modified technique, so that only a few special points need be mentioned here.

1. Conversion to occiput. DeLee (2) attributes his success to his leading the flexed head into the pelvis, applying forceps and then following with a few slight tractions. Titus recommends Willett's forceps or a tenaculum over the vertex to maintain flexion, as has been mentioned under the management of early brow presentations.

2. Version. Three difficulties are peculiar to the version of a face or brow presentation: (1) the adaptation of the uterus to the long fetal ellipse; (2) the extreme extension of the back, which makes the anterior foot inaccessible; (3) the after-coming head—(a) the great uterine contraction force acting on the hyperextended head makes flexion doubly difficult, and (b) the large caput succedaneum over the sinciput may be wedged against the promontory and prevent the aftercoming head from dropping into the hollow of the sacrum.

These difficulties may be met with as follows: (1) deep anesthesia and atropine will relax the uterus; (2) flexion of the head and then of the back by pushing in the chest will bring the feet nearer; (3) Piper (9) solves the problem of the aftercoming head by "rotating it with forceps into almost a transverse position, thus bringing it into the inlet, after which the forceps may force it into the necessary flexion."

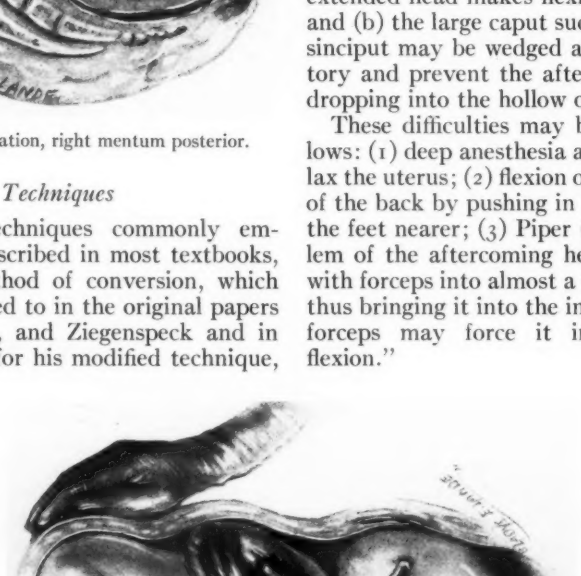

Fig. 5. Manual rotation of the shoulders in a right posterior mentum position. The left hand frees the right shoulder from the lower uterine segment. With the fingers locked in the axilla and on shoulder, the left hand rotates the shoulder clockwise. Rotation of the shoulder facilitates manual rotation of the head.

3. Low forceps (mentum directly anterior). Forceps are applied in the usual occipitomental diameter. However, it must be remembered that the mentum is the point of direction which the upper surface of the forceps faces. Therefore, each blade will come to lie in front of the opposite ear instead of in front of the corresponding ear, as in a vertex presentation; i.e., the left blade, held in the operator's left hand, is applied first; this blade goes to the left side of the pelvis and comes to lie in front of the right ear. The facial axis corresponds to the sagittal suture in a vertex presentation. After applying the forceps and before locking them, the operator holds the handles high, to a point 1 centimeter below the level of the mouth, thus allowing the blades to fall into the hollow of the sacrum and permitting a biparietal-malar application in the occipitomental diameter. He then makes traction downward and increases extension until the chin is delivered from under the symphysis. The direction is now raised so gradually that the exposed trachea will not be injured; extreme flexion delivers the occiput.

It should be emphasized that because of the stretching of the lower uterine segment, rotation, even from an anterior oblique position, should never be attempted by any method but Kielland forceps or manual rotation.

4. Kielland forceps. The authors are indebted to Dr. Julius Kurzrock for his collaboration in describing the following technique of the application of Kielland forceps to face presentations, as practiced at Harlem Hospital. Kielland forceps are employed only when the face is well engaged.

Mentum obliquely anterior. As just stated, Kielland forceps are used for anterior face presentations in the oblique diameter as well as in the transverse and posterior diameters. The application of the Kielland to the mentum obliquely anterior is similar to that already described for the application of low forceps to the mentum directly anterior. The blades are again held high before being locked. As in all Kielland deliveries, the handles should never be raised above the horizontal. If delivery has not been effected when this level is reached, the handles are opened slightly, depressed singly to the perineum, locked and again raised to the previous level. This procedure may be repeated until the infant is delivered.

Fig. 6. Face presentation. Flexion of the head with the Kielland forceps, after the chin has been stemmed under the symphysis.

Mentum transverse. In the mentum transverse position, the authors prefer the Kielland to manual rotation. The usual Kielland inversion method is used. The operator introduces the anterior blade first. In a right mentum transverse the right (male) blade is anterior, and in a left mentum transverse the left (female) blade is anterior. The anterior blade, held like a sword, is inserted along the palm of the vaginal examining hand with the toe of the blade pointing upward and the cephalic surface anterior. The blade is then rotated so that the cephalic (concave) surface rests on the convex surface of the face. This should be done by rotating the blade "in the direction of the button," that is, by allowing the finger guards to follow the button around a semicircle; the blade is thus rotated about an arc of lesser curvature. The operator must exercise great care in the introduction of the anterior blade in order to avoid injury to the stretched lower segment. The posterior blade is then introduced as a shovel along the palm

of the vaginal hand, which is applied closely to the face of the fetus. The blades are locked toward the side to which the mentum points; further extension is accomplished by swinging the blades toward the opposite side. The buttons now face the chin. Rotation of 90 degrees is performed so that the buttons and the chin point anteriorly. Delivery is brought about as in a mentum anterior.

Mentum obliquely posterior. Because rotation with Kielland forceps is so formidable in the mentum obliquely posterior position, the authors first attempt manual rotation to at least a transverse. If this is impossible, the application is similar to that used in the transverse position, except that the axis of the blades, in order to correspond to the facial axis, is oblique. The buttons again face the chin, and rotation brings the buttons and chin anterior. It may be easier to insert the blades in this position not directly in the midline, but on the side to which the side of the face points, where it is less "crowded." Thus, in a right mentum posterior, right occiput posterior or left mentum anterior position, the anterior blade is inserted just to the maternal right of the midline and the posterior blade just to the maternal left of the midline. In left mentum posterior, left occiput posterior, or right mentum anterior positions, the anterior blade is inserted just to the maternal left of the midline, while the posterior blade is inserted just to the right of the midline. In transverse positions, mentum or occiput, both blades are inserted in the midline.

Mentum directly posterior. In a direct posterior, where the chin becomes impacted in the sacrum, spontaneous delivery of a normal sized infant is impossible, as explained under "Mechanism." It may, however, be feasible to rotate with Kiellands to a deliverable position. The right (male or lockless) blade, held in the left hand, is introduced first to the left side of the pelvis; the left (female or locked) blade is then held with the right hand and introduced to the right side of the pelvis anterior to the first blade in order to avoid crossing handles when the blades are locked. It is often necessary to push the head slightly upward to facilitate rotation. The operator must bring about rotation slowly and deliberately, maintaining extension of the face throughout the operation until the chin is brought under the symphysis pubis. Extraction is then accomplished as described above for mentum anterior.

5. *Manual rotation.* Manual rotation of the head is usually facilitated by previous rotation of the shoulders, by locking the fingers in the axilla after freeing them from the lower uterine segment. Rotation of the head is accelerated by abdominal pressure on the occiput by the assistant.

SUMMARY

1. Eighty-seven face and 13 persistent brow presentations were found among 46,058 deliveries at Harlem Hospital, New York, from January 1, 1914, through June 20, 1942. There was a relative frequency of 6.7 face presentations to 1 persistent brow presentation; a gross incidence of 1 face presentation among 529 deliveries and 1 persistent brow presentation among 3,543 deliveries; and a total incidence of 1 in 461 deliveries, either face or brow.

2. Among 79 cases, some etiologic factor was found in 46, or 58.2 per cent. At least borderline disproportion (contracted pelvis or a child weighing more than 8½ pounds) was present in 29 cases, or 63.5 per cent, of all cases in which some etiologic factor was found. All cases of face presentation therefore require careful roentgen pelvimetry.

3. Other etiologic factors found in this series were coils of cord around the neck, hydramnios, placenta previa and low implantation, external cephalic version, and fetal monstrosities such as anencephaly, meningocele and dolichocephaly. All causes except coils of cord around the neck can be confirmed or eliminated by roentgenography.

4. Two face presentations occurred subsequent to external cephalic version.

5. The average birth weight among 64 full term children in this series was 7 pounds, 12.2 ounces, about two-thirds of a pound higher than the average full term newborn child at Harlem Hospital. However, face presentations occurred in 12 premature deliveries.

6. Multiparity was proved statistically to be a predisposing factor in this series. In cases

in which parity was recorded, 72.1 per cent of the mothers were multiparas. This fact is consistent with the higher birth weights among face presentations and the progressively larger babies produced by the same mother in successive pregnancies. The obliquity of the uterine axis to the pelvic inlet resulting from the relaxed abdominal wall in multiparas would predispose only to the formation of posterior mentum presentations from occiput anteriors.

7. Almost 2 of 3 of all face presentations delivered spontaneously, including more than 3 of 4 mentum anterior and transverse and 1 of 3 mentum posterior; but less than 1 of 4 persistent brow presentations (all small babies) delivered spontaneously as such. In mentum anterior and transverse presentations, therefore, provided no disproportion exists, a policy of watchful waiting is followed as long as progress persists.

8. A tendency to early rupture of the membranes was observed and found to be associated with a prolonged first stage. Early rupture of the membranes therefore necessitates both a reconsideration of the planned management and careful roentgen pelvimetry, in the event the latter has been previously neglected.

9. Diagnosis by abdominal palpation was found to be difficult. Roentgenography was employed in only the most recent cases. In 4 cases the diagnosis was made solely in this manner, while in 6 others a roentgenogram confirmed the face or brow presentation previously suspected.

10. A maternal mortality rate of 1.15 per cent among 87 face presentations and of 15.4 per cent among 13 persistent brow presentations, or a combined rate of 3.0 per cent, was recorded; maternal morbidity was not markedly increased.

11. Of the full term nondeformed children, 19.6 per cent of the face and 20 per cent of the persistent brow presentations were stillbirths or neonatal deaths within 24 hours, a combined mortality rate of 19.8 per cent.

12. Five per cent of all the children in this group were monsters; these comprised 25 per cent of all premature deliveries, but only 2.3 per cent of full term deliveries.

13. Among 5 cesarean sections performed on face presentations, there were no fetal or maternal deaths. One peritoneal exclusion cesarean on a brow presentation after 35 hours of labor and 2 hours of ruptured membranes resulted in death from generalized peritonitis and septicemia.

14. The technique followed for the application, rotation, and extraction of face presentations with Kielland forceps is described.

CONCLUSIONS

1. Abdominal palpation is unreliable as a means of diagnosis of face presentations, especially the classical criterion of the relative position of the cephalic prominence.

2. Because of the high frequency of disproportion as a predisposing factor toward face and brow presentations, the early use of the roentgen-ray, especially with pelvimetry, is strongly advocated.

3. Because of the higher maternal and fetal morbidity and mortality and the greater incidence of disproportion and prolonged labor with dystocia accompanying extension of the head, cesarean section should be given greater consideration than heretofore in early diagnosed cases of face presentations, especially in primiparas.

4. The predisposing factors of multiparity and large babies to face presentations are thought to be directly correlated in view of the fact of the increasing birth weights of babies born in succeeding pregnancies to the same mother.

5. The high percentage of uneventful spontaneous deliveries among face presentations is sufficient grounds for our maxim, in the absence of disproportion: "If a 'face' is making progress, leave it alone."

6. A case "type" has been found and is presented for serious consideration: A multipara enters the hospital at term in very early labor because of ruptured membranes. Although her previous children were much smaller, the large baby is not considered significant, because of the multiparity of the mother. The face presentation is usually not recognized. A prolonged, morbid labor results from the cephalopelvic disproportion, complicated by a face presentation and early

ruptured membranes. A difficult vaginal delivery, perhaps by axis traction forceps, results in a stillbirth or neonatal death and a morbid patient in poor condition. A cesarean section should have been preferred, despite multiparity.

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ONE ASPECT OF THE POSTTRAUMATIC SYNDROME IN CRANIOCEREBRAL INJURIES

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THE purpose of this paper is to present a hypothesis, the acceptance of which helps prevent and cure, in a sizable number of patients, the posttraumatic syndrome of headache, dizziness, and mental and physical fatigue. It is applicable to civil and military practice and so justifies mention today.

Briefly the hypothesis is this: An injured and therefore unstable vasomotor system, incapable of quickly supplying blood to the brain, is the cause of the symptoms of dizziness, light headedness, blackouts, headaches, and mental and physical fatigue in at least some patients. If this be true one should take steps to restore the function of the injured vasomotor centers as soon as possible and so prevent a train of symptoms, which have an organic basis, but may, as the weeks go by, become clouded by a functional superstructure.

This idea (1) developed and became useful to us some 6 years ago after observing the following patient: A young adult, well developed and accustomed to heavy work, was referred for an opinion because of incapacitating headache and dizziness. Some 6 months before he had been unconscious for about one-half hour following a head injury. He was kept flat in bed for 8 or 10 weeks, then was allowed to be up. Incapacitating dizziness and some headache had persisted after he was allowed to be up.

Examination disclosed that this patient's dizziness was really a faintness, light headedness, or mild blackout, brought on when he changed from the horizontal to the erect posture. This was readily explained by his inadequate vasomotor system. In the horizontal position the systolic pressure was 120—on standing the patient's pulse disappeared at the wrist, he became white, and he would nearly faint. A few moments after standing erect the patient's pulse could be felt returning and he would straighten up and feel better. However, any sudden movement would bring on the syndrome in a milder degree. Not having received advice this patient had continued to seek the horizontal position in which he was most comfortable, spending all his time lying down. Any position or exercise that might have restored the vasomotor system was avoided as the patient thought that the production of his symptoms in this way was harmful.

The situation was explained to the patient: for 3 months he co-operated in a regimen which involved sleeping with the head and shoulders well up—never lying down flat day or night. Stooping exercises were practiced many times a day and tolerance built up for this movement. Also he spent many hours in the open air walking and swimming. In 3 months the systolic pressure responded immediately to a change of posture. All symptoms had disappeared. The patient returned to work without further compensation and has remained well, with good morale.

Our interpretation of this case was somewhat as follows: The man's vasomotor centers had been injured along with the rest of the brain—he had been kept flat on his back for some 10 weeks and during this period his injured vasomotor system had adjusted itself to supply blood to the brain in adequate amounts only in the horizontal position—the patient found himself comfortable when lying flat and so spent almost all his time in that position, in this manner never stimulating the vasomotor system to function adequately in the upright position.

This of course was an extreme case, the blood pressure dropping to zero when the upright position was suddenly assumed. We postulated minor degrees of disturbed function in circulation that could not be demonstrated by

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the ordinary means of recording blood pressure but yet might account for what the patient called dizziness, headache, and mental and physical fatigue.

Largely on the basis of this experience, we have for some years advised elevation of the head and shoulders, sitting on the edge of the bed, and getting up as soon after the injury as possible. This means that most patients are up a few days after a head injury. In general it is felt that early erect posture will more quickly retrain the injured vasomotor system and prevent it from becoming conditioned to the horizontal position and so unable to function adequately when position is changed rapidly. Patients are quickly out of bed after various traumatizing cerebral operations. One fails to see why a very early erect posture and some activity should do anything but improve circulation through cerebral tissue damaged by violence to the skull.

Psychologically too, of course, such procedures are valuable, the relatives and other patients see that progress is being made; quite a different attitude is produced from that extreme of keeping a patient flat in a dark room with no visitors for weeks on end.

The optimum time to prevent or cure a patient of headache, dizziness, mental and physical fatigue is during this first stay in hospital and not some months later. Keeping patients in hospital is often difficult but an added few weeks of active treatment may save months of disability.

For instance, a recent patient was unconscious about 15 minutes, had blood in the cerebrospinal fluid, and for about a week was definitely dull and apathetic. Once or twice the advisability of exploratory burr holes for subdural blood was considered; after about 10 days there were complaints of headache and dizziness on change of posture; there was also a definite interest in compensation. It is reasonably certain if this patient had been sent out of hospital at the end of 2 or 3 weeks he would have been a problem 3 or 4 months later. An active regimen was commenced—he was made to get up when he wanted to lie around in bed, made to shave himself, and then gradually persuaded to go to the occupational therapy department. He became interested in various games which involved stooping, such as table tennis, playing checkers on the floor so that he had to stoop to make a move, and various other comparable games. He was also encouraged to do stooping exercises every time the house surgeon or nurse went around to see him. Under this regimen partly psychological and partly physiological he got well in 7 weeks and admitted on discharge that he was ready to go to work and that he was free of headache and dizziness. The case was immediately settled with the insurance company, not only to their benefit but more important, to the benefit of the patient. One admits that these times make it easier to handle a problem like this because it is so easy for a patient to get a job, and he has the stimulus of seeing everybody busy and at work. It is quite definite that the Compensation Board of Ontario is not now having nearly the number of posttraumatic syndromes that they had in hard times, this of course we always suspected but it has been clearly demonstrated during this unusually remunerative period for the manual worker.

This general idea of what one might term: convalescent treatment to improve the tone of the vasomotor system, is advocated in civilian and military hospitals. One postulates that many patients remain in bed far too long after a head injury and when finally allowed up little or no effort is made to restore their physical and mental well-being. Especially is it important to restore the tone of the injured vasomotor centers as early as possible. Facilities for such treatment are as yet inadequate and undeveloped but it is always possible to improvise simple measures and bolster morale with common sense advice. In our experience the best time to help the patient is during the first few weeks after the head injury, not some months later.

It is admitted of course that many patients cannot be rehabilitated in a short period. An ideal regimen might be the transfer of these patients, who are obviously not going to be fit in a few weeks, to centers with facilities for carrying on a continuous active regimen for months. Thus there should be no prolonged gap between the early active regimen and the stay in special centers. Such centers of course

require adequate specialist personnel, a good occupational therapy department, a gymnasium, and physical instructor, game facilities, etc., and finally rehabilitation facilities to place individuals who have a permanent partial disability.

As yet all this is inadequately developed in civilian practice. In the armed forces the problem may be more efficiently approached and developed.

NOTE. This paper was written some six months ago. Further consideration of the problem leads one to feel that early attention to the restoration of vasomotor tone is important; but probably more important is an active regimen instituted by the surgeon to prevent a functional syndrome —so difficult to deal with when once established. Surgeons are prone to pay little attention to this problem which is so important in the case of the patient with a craniocerebral injury.

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THE VALUE OF THE STONE DISSOLVING AGENT, SOLUTION G, IN THE TREATMENT OF ALKALINE INCRUSTATIONS OF BLADDER LESIONS

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THE treatment of urinary infections with persistently alkaline urine represents a difficult problem particularly in patients in whom complicating factors such as necrosis due to ulcer or tumor formation favor development of incrustations and stones. The usual therapeutic procedures consisting of attempts at acidifying the urine by diet and drugs supported by removal of stones and incrustations through the cystoscope are tedious and do not yield satisfactory end-results in a considerable number of cases. Also the administration of various drugs of the sulfonamide group has been of limited value only.

Most commonly encountered in these infections are bacteria of the Bacillus coli group. Of these Bacillus proteus and Bacillus pyocyaneus have particularly marked urea splitting properties causing persistent alkalinity of the urine due to formation of ammonia. While these bacteria grow best in alkaline medium it has been demonstrated that they cannot survive or multiply in urine of *p*H 4.5 or 4.0 or less (5). It is obvious therefore, that favorable end-results can be accomplished best if one succeeds in decreasing the *p*H of the urine to bactericidal levels. However, such low *p*H levels can rarely be attained by the use of drugs and diet alone or in combination.

Attempts have been made in the past to cure alkaline cystitis by repeated irrigation of the bladder with various acid solutions. The results accomplished with weak solutions of acetic or phosphoric acid were discouraging as a rule because inorganic acids are poorly tolerated by the bladder mucosa. A more favorable response was obtained by Wilhelm and Levine who treated 9 patients by repeated instillations of a citric acid sodium citrate solution at 30 minute intervals. However, Wilhelm and Levine emphasized that bladder irritation of considerable degree developed in several instances which required local application of novocain and opiates by mouth during the course of treatment.

Recent investigations by Suby, Suby, and Albright (3) have confirmed the irritating effect of citric acid sodium citrate solution on the bladder mucosa. While investigating the effect of various acid test solutions on the bladder mucosa in rabbits for the purpose of finding a stone dissolving agent they found that lavaging the rabbit's bladder with a citric acid sodium citrate solution of *p*H 4.0 caused hematuria after 15 minutes. Continued lavage for 4 hours produced complete destruction of the epithelium as well as edema and hemorrhages involving the entire bladder wall. Suby, Suby, and Albright found after long and thorough experimentation that the irritating effect of citric acid sodium citrate solution could be practically eliminated by addition of magnesium oxide without impairing the stone dissolving properties of citric acid. This solution, which is referred to by these investigators as "solution G," has a *p*H of 4.0 and is composed as follows: citric acid (monohydrous), 32.2 grams; magnesium oxide (anhydrous), 3.8 grams; sodium carbonate (anhydrous), 4.4 grams; distilled water *ad* 1000 cubic centimeters.

Suby, Suby, and Albright found that continuous irrigation of the bladder in rabbits with solution G for 4 hours produced no gross damage to the mucosa, and only slight edema of the bladder wall was found on microscopic examination. Clinical investigations by these authors revealed that solution G is well tolerated by the mucosal lining of the human urinary tract and that alkaline stones could be dissolved with this solution without producing ill effects. Suby and collaborators were able to accomplish favorable results from the use of solution G in 20 patients with inorganic calculi, and they demonstrated that even large staghorn stones were dissolved completely after continuous irrigation for 40 days. Thus Suby, Suby, and Albright have brought the problem of dissolving inorganic stones of the urinary tract considerably nearer to its solution (2, 3).

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The bactericidal action of solution G has been investigated recently by Sauer and Neter who found that solution G produced bactericidal effects within 24 to 72 hours at 37 degrees C. against strains of Bacillus coli, Bacillus proteus, Bacillus morgani and Streptococcus faecalis. It was also demonstrated that the admixture of urine to solution G caused an increase in *p*H coinciding with a decrease in antimicrobial activity against Bacillus coli. While an equal mixture of solution G with urine of *p*H 7.6 produced appreciable bactericidal effects, it was found that a mixture of 75 per cent urine (*p*H 7.6) and 25 per cent solution G had no appreciable antimicrobial properties.

During the past year we have carried out clinical investigations as to the usefulness of solution G in the treatment of urinary infections which were characterized by persistent alkalinity of the urine with resulting tendency to formation of incrustations and stones. Subjected to treatment were 21 patients who had the following underlying pathological conditions: 13 patients had ulcerations of the bladder to which incrusted slough was adherent, 1 patient had alkaline cystitis with marked tendency to formation of stones and incrustations, 5 patients had necrotic bladder tumors which were covered by alkaline incrustations, and the remaining 2 patients had inorganic stones of the urinary tract.

In carrying out treatment the following method was employed: A three way Foley bag catheter (Foley-Alcock) was placed indwelling and solution G was administered by means of an intravenous clysis outfit at a rate of from 40 to 60 drops per minute. Continuous drainage of the bladder was assured by allowing the mixture of urine and solution to escape through the return tube of the catheter. More recently we have elevated the tube draining the return fluid 20 to 30 centimeters above the symphysis. Thus tidal drainage and periodical distention of the bladder with a mixture of urine and solution G were effected. From 3000 to 4000 cubic centimeters of solution G was used daily and since the 24 hour fluid intake of the patients did not exceed 3000 cubic centimeters it can be assumed that the return fluid contained at least 50 per cent of solution G. In addition regular irrigation of the bladder with solution G was carried out 2 to 3 times daily and urinary antiseptics were administered orally. Cystoscopic re-examinations were usually made at weekly intervals for the purpose of determining whether or not continuation of treatment was indicated. Depending on the response to treatment, irrigation was carried out for a period of from 1 to 4 weeks.

Irrigation of the bladder with solution G was well tolerated in all patients but one. This patient had an incrusted tumor in the vesical neck region, and treatment had to be discontinued after 2 days because of persistent bladder tenesmus. Further observation of this patient revealed that he did not tolerate an indwelling catheter even without the use of solution G, and it can be presumed, therefore, that the irritation was due to the location and character of the primary lesion.

In the remaining 20 patients no appreciable ill effects developed. However, on cystoscopic examination increased injection and thickening of the bladder mucosa were observed in all patients after exposure to solution G for more than 3 weeks. These changes were transient and disappeared spontaneously 1 to 2 weeks after treatment was completed.

In the group of 13 patients with incrusted ulcerations of the bladder, ulcer formation developed after abdominoperineal resection for carcinoma of the rectum in 2 cases. In the remaining 11 cases ulcer formation occurred following radium irradiation for cancer of the cervix in 9 instances and after interstitial radiation for carcinoma of the bladder in 2 instances. None of these 13 patients showed evidence of tumor during and after treatment with solution G. The ulcerations had been present for less than 1 year in 8 cases. In the remaining 5 patients the lesion had persisted from 1 to 2 years in 2 cases, and from 7 to 8 years in 3 cases. Various methods of treatment, such as oral administration of urinary antiseptics, weekly instillations of silver nitrate, and repeated removal of incrustations with the Young rongeur, had been employed in the latter 5 patients prior to irrigation with solution G, but the response to treatment was unsatisfactory in each of these cases.

The following results were accomplished by the use of solution G in this group consisting of 13 patients.

Complete cure with resulting scar formation at the site of the lesion was obtained in 8 cases (61.5 per cent). In 4 of these cases the ulcers had persisted for less than 1 year and in the other 4 patients for 1½, 2, and 7 years (2 cases). Treatment was carried out in 4 cases for 2 weeks and in 4 cases for 3 weeks. Only in 1 patient treatment had to be repeated for a period of 10 days because recurrent formation of incrusted slough developed 2 months following the first course of treatment. All of these 8 patients are free of symptoms at the time of writing and the urine, persistently alkaline before treatment, has become and remained acid since treatment was commenced.

The effectiveness of this method of treatment is illustrated best by the following case report:

Ch. C. No. 22734, a 52 year old white male, was admitted to the hospital on May 22, 1935, for the treatment of a solid infiltrating carcinoma of the bladder located at the left border of the trigone. Transurethral resection of the tumor followed by implantation of radon was carried out resulting in disappearance of the tumor. However, an incrusted radium slough developed 3 months after treatment which persisted for more than 7 years in spite of treatment consisting in repeated removal of slough and incrustations as well as urinary antiseptics by mouth. When he returned for re-examination on August 22, 1942, he had almost complete urinary retention, severe dysuria and frequency, and he was passing bloody urine which contained gravel. The *p*H of the urine was 7.4. Cystoscopic examination revealed 200 cubic centimeters of turbid residual urine. The bladder was very sensitive and had a capacity of 250 cubic centimeters. The entire trigone was markedly edematous and an area of incrusted slough covering the left border of the trigone was seen. The lesion extended downward to the vesical sphincter which was completely surrounded by sloughing tissue to which calcareous deposits were adherent. Chemical analysis of the calcareous deposits revealed magnesium ammonium phosphate with some calcium oxalate.

Following cystoscopic examination a No. 24 F. 30 cubic centimeter 3 way Foley bag catheter was placed indwelling, and drip irrigation of the bladder with solution G was started. Cystoscopic re-examinations were carried out at weekly intervals showing steady improvement in the appearance of the bladder. Treatment was discontinued 4 weeks later on September 19, 1942, at which time neither slough nor incrustations were seen on cystoscopic examination. When he returned for re-examination 2 months later (November 16, 1942) he was feeling well and he had no symptoms referable to the genitourinary tract. Cystoscopic examination revealed scar formation at the site of the previous ulceration. He was last examined July 30, 1943. He had no dysuria, his urine was clear, *p*H 4.4, the bladder capacity had increased to 320 cubic centimeters and cystoscopic examination showed no pathological condition except for scarring at the left border of the trigone.

The results accomplished in the remaining 5 cases of the group of 13 patients with incrusted bladder ulcerations were less spectacular although evidence of favorable response to treatment with solution G was apparent. In 4 of these 5 patients treatment resulted in marked relief from symptoms coinciding with disappearance of the calcareous deposits. However, in spite of continuous drip irrigation for a period of from 3 to 4 weeks, some sloughing tissue remained adherent to the surface of the ulceration in these 4 cases. In 2 of them recurrent formation of incrustations developed 2 months after treatment was discontinued but these disappeared promptly after a second course of treatment.

It is of interest that these 4 patients were subjected to irrigation with solution G only a short time after radium ulcerations had developed. It must be kept in mind that in such cases healing occurs only after the circulation of the affected area is re-established. Experience has shown that as a rule considerable time elapses before these prerequisites to cure are fulfilled, and months or even years may go by before healing of radium ulcers takes place. In view of these considerations it may be presumed that the use of solution G in these 4 cases was of limited success only, because the lesions were too recent. In contrast, it is our impression that the favorable results obtained in patients with ulcerations of long standing were due to the ability of solution G to dissolve incrustations which prevented healing of lesions as repair of the cirulation had taken place before treatment with solution G was commenced.

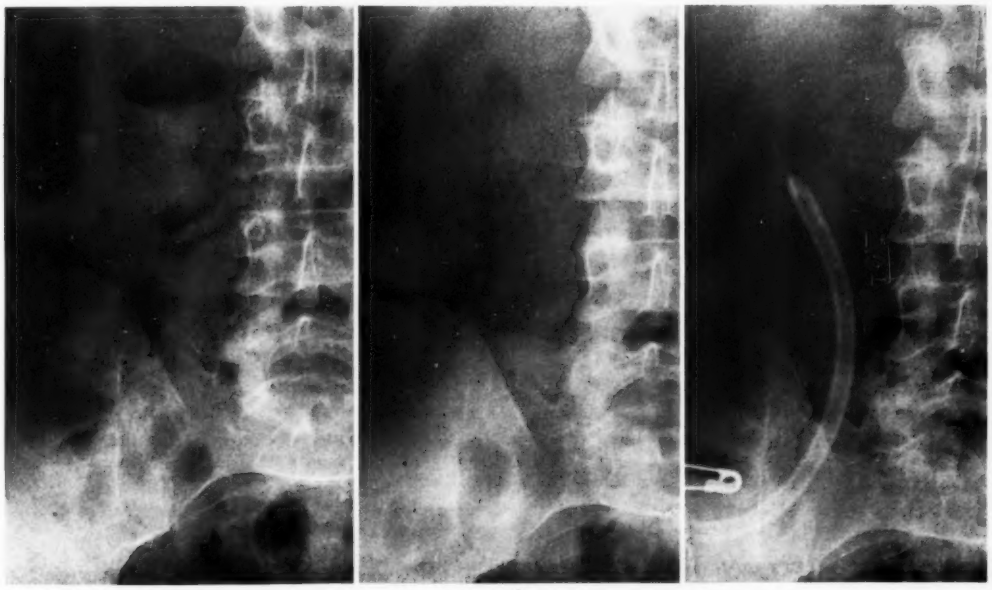
In the last of the 13 patients with incrusted bladder ulcers treatment had to be discontinued after 1 week because the patient was an epileptic and mentally unbalanced. Appreciable regression in the amount of calcareous deposits occurred following the use of solution G although improvement was of short duration only.

Continuous drip irrigation with solution G was employed in 5 patients with carcinoma of the bladder. Four of them had papillary infiltrating tumors and 1 had a solid infiltrating carcinoma. All of these cases had persistently alkaline urine and the tumor was covered by incrustations which caused considerable discomfort to the patient and prevented successful employment of endovesical methods of treatment.

Disappearance of the calcareous deposits coinciding with a change of the urine from alkaline to acid *p*H levels took place in 4 of these cases. Treatment yielded no results in 1 patient who did not tolerate an indwelling catheter. It is obvious that the ultimate outcome in the 4 patients who responded favorably to treatment was and will be determined by the character of the primary lesion. Aside from this consideration we believe that the use of solution G is a valuable adjunct in the treatment of such cases because dissolving of incrustations and gravel will not only improve dysuria and frequency but it will render some of these tumors more suitable for treatment.

We had the opportunity to investigate the effects of solution G in 2 patients with urinary calculi.

The first of these patients developed stone formation in the right kidney pelvis 1 year following bilateral ureterostomy and total cystectomy for carcinoma of the bladder (Fig. 1a). Bacteriological examination of the urine obtained from the right kidney revealed Bacillus proteus and Streptococcus faecalis. The urine of the left kidney had a *p*H of 4.8 while the urine from the right kidney was of *p*H 7.2. In carrying out treatment a No. 20 F. 3 way 5 cubic centimeter Foley bag catheter was inserted through the ureterostomy into the moderately dilated kidney pelvis and the balloon of the catheter was inflated with 3 cubic centimeters of fluid.



a b c

Fig. 1. a, X-ray film showing stone formation in the right kidney pelvis 1 year after bilateral ureterostomy and total cystectomy for carcinoma of the bladder. b, On the 9th day, when treatment was discontinued, the size of the stone had decreased from 7 to 2.5 millimeters while stone shadow in inferior minor calyx showed no changes. c, Roentgenological examination 32 days later revealed complete disappearance of the stone in the kidney pelvis.

Continuous drip irrigation with solution G was employed in the usual way for a period of 9 days. Except for slight intermittent hematuria no ill effects developed during and after treatment. X-ray pictures were made twice weekly and it was found that the density of the stone shadow in the kidney pelvis decreased after irrigation for 3 days. On the 9th day, when treatment was discontinued, the size of this stone had decreased from 7 to 2.5 millimeters while the appearance of the stone shadow in the inferior minor calyx showed no changes (Fig. 1b). The patient was discharged from the hospital 2 days later and he was instructed to irrigate his right kidney pelvis three times daily with solution G. Roentgenological re-examination 30 days later revealed complete disappearance of the stone in the kidney pelvis (Fig. 1c). However, since the stone in the right inferior minor calyx showed no evidence of decrease it may be presumed that the solution did not reach this calculus in sufficient amounts to effect its dissolution. For the purpose of avoiding development of new stones the patient was advised to continue irrigation of the kidney pelvis with solution G and x-ray pictures made repeatedly during the past months showed no evidence of recurrent stone formation up to the time of writing.

The second patient had an adenoma of the prostate complicated by a bladder stone measuring 2.8 by 2.1 centimeters in size. Continuous drip irrigation with solution G was carried out for a period of 3 weeks but the response to treatment was not satisfactory. Only regression in the size of the stone to 1.7 by 1.2 centimeters was accomplished, and, since continuation of treatment was contraindicated because of fever, surgical removal of the stone followed by 2d stage suprapubic prostatectomy was carried out. The stone proved to be brittle, and chemical analysis revealed that it consisted of magnesium ammonium phosphate.

In addition solution G was employed successfully in the treatment of 1 ambulatory patient with a suprapubic cystostomy for carcinoma of the prostate in whom persistently alkaline urine caused formation of incrustations around the catheter. This patient was instructed to install 50 cubic centimeters of solution G into the bladder 2 to 3 times daily. The urine became and has remained acid 1 week following the use of the solution, and the catheter which prior to that had to be changed at weekly intervals is now being replaced every 4 weeks without showing evidence of incrustations.

In all those patients who were treated by continuous drip irrigation determinations of the *p*H of the return fluid were carried out at frequent intervals. It was found that the *p*H of the return fluid varied from 4.5 to 4.9. Such a degree of acidification was attained even in patients whose urine prior to treatment was as alkaline as *p*H 8.0. These findings indicate that solution G has satisfactory buffer properties. It should be re-emphasized in this connection that sufficiently large amounts of solution G were used to assure that

the return fluid contained at least 50 per cent of the solution.

Complete bacteriological studies, including direct microscopic examination and culture of the urine were carried out in 9 of the 21 patients treated. In 3 patients only 1 micro-organism was discovered; in 5 patients 2 different species of bacteria were present, and in 1 patient 3 different bacteria were encountered.

The following organisms were recovered: Bacillus pyocyaneus, Staphylococcus aureus, Streptococcus nonhemolyticus, and Streptococcus faecalis, 3 times each; Bacillus proteus, Bacillus coli, anaerobic streptococcus, and Bacillus funduliformis, once each.

Bacteriological examinations of the return fluid were carried out every 2d to 3d day. Complete sterilization was not achieved in any of these 9 cases while they were under treatment. However, it was found that treatment resulted in an appreciable reduction in the number of organisms in 5 patients. We are inclined to believe that this reduction in the number of bacteria was, in part at least, due to the radical change of the *p*H in the contents of the bladder.

In concluding it is our impression that solution G is of value not only as a stone dissolving agent as originally suggested by Suby, Suby, and Albright but is of value also in the treatment of urinary infections which are complicated by formation of alkaline incrustations. This method of treatment presents no technical difficulties and it may yield quick and gratifying results in patients who otherwise would have to undergo tedious and not always successful treatment.

SUMMARY

Solution G, a citric acid magnesium oxide sodium carbonate solution of *p*H 4.0 was employed in the treatment of 21 patients who had persistently alkaline urine with tendency to formation of stones and incrustations.

Solution G was administered as a rule by continuous drip irrigation through a 3 way Foley bag catheter for a period of from 1 to 4 weeks. Treatment was well tolerated by all but 1 patient with an incrusted carcinoma in the region of the vesical sphincter.

The most favorable results were obtained in 13 patients with incrusted bladder ulcerations. Cure with resulting scar formation took place in 8 of these cases, 4 patients showed marked improvement, and 1 patient responded with temporary improvement after treatment for only 1 week's time.

Disappearance of incrustations was accomplished in 4 of 5 patients with incrusted carcinoma of the bladder.

In 2 patients with urinary calculi treatment resulted in dissolution of 1 of 2 stones in the kidney pelvis and regression in size of the calculus in the other patient.

In addition, acidification of the urine was accomplished in 1 patient with suprapubic cystostomy for carcinoma of the prostate.

Complete bacteriological studies were carried out in 9 of the 21 patients treated. Although sterilization of the urine was not achieved in any of these 9 cases it was found that treatment resulted in marked reduction in the number of organisms in 5 cases. Since repeated determinations of the *p*H of the return fluid yielded invariably *p*H levels of from 4.5 to 4.9, it is suggested that the reduction in the number of bacteria is due largely to the radical change of the *p*H effected by this method of treatment.

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POLYPOID LESIONS OF THE COLON OF CHILDREN

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IN most of the articles which deal with the significance of blood in the stools of infants and children, polypoid lesions of the rectum are mentioned as possible sources of the blood. Since the development of proctoscopy, polypoid lesions of the rectum and sigmoid have been demonstrated in an increasingly large number of cases in which the patients are infants and children. However, little emphasis has been placed upon the occurrence, diagnosis, and treatment of noninflammatory polypoid lesions of the colon which are situated beyond the reach of the sigmoidoscope. A realization of the fact that they do occur, with or without concomitant polypoid lesions of the rectum, should lead to more frequent search for them and to their removal.

This paper is based on 11 cases of polypoid lesions of the colon. In all of these cases the patients were children, and the colonic lesions were situated beyond the reach of the sigmoidoscope. Seven of these cases were included in a previous report of 49 cases of polypoid lesions of the rectum and colon which was made by one of us (R.K.) (4). Because polypoid lesions that are situated beyond the reach of the sigmoidoscope present a special problem, these 7 cases have been included in the present report.

AGE AND SEX

Of the 11 patients, 4 were girls and 7 were boys. The ages of the patients ranged from 3 to 14 years. The ages of the patients in the individual cases were as follows: 3 years in 3 cases, 4 years in 1 case, 5 years in 1 case, 6 years in 1 case, 7 years in 2 cases, 9 years in 1 case, 10 years in 1 case, and 14 years in 1 case.

SYMPTOMS

Symptoms had been present for 10 days to 7 years before the patients were brought to the Mayo Clinic. The duration of symptoms in the individual cases was as follows: 10 days in 1 case, 6 weeks in 1 case, 5 months in 1 case, 14 months in 1 case, 2 years in 2 cases, 2½ years in 1 case, 4 years in 1 case, 5 years in 1 case, and 7 years in 1 case. In other words, the duration of symptoms varied greatly. The symptoms had been present for less than a year in only 3 of the cases.

Blood in the stools was the outstanding symptom. It was present in all of the cases. In 8 of the 11 cases the amount of blood in the stool never had exceeded 1 fluid drachm (4 c.c.). The blood appeared on the outside of a formed stool or at the end of the stool. Clotted blood was observed in 4 cases. In 1 case the loss of blood had been sufficient to necessitate transfusion. In this case, two transfusions had been given before the patient was brought to the clinic. The blood appeared in the stools at various intervals. In most cases it was observed at intervals of 1 day to a week but in 2 cases it occurred at intervals of 1 week to several months.

Small amounts of clear or blood-tinged mucus were observed in 5 cases. In 2 of these cases the amount was considerable. A moderate amount of mucus was observed in 2 additional cases. In the remaining 4 cases, mucus either was not observed or no mention was made of its presence.

Pain is not a prominent symptom of polypoid lesions of the colon. In 7 of the 11 cases, there was no history of pain. In 1 case, pain had occurred frequently. One patient occasionally had had periumbilical discomfort which had been relieved by enemas. In 1 case, discomfort had occurred in the left side of the abdomen, and in another case, the patient had had dull, intermittent pain in the left side of the abdomen for 4 days prior to examination at the clinic.

Diarrhea was present in only 1 of the cases. This symptom is of importance in the differential diagnosis of some of the other diseases that have sometimes been confused with polypoid lesions of the colon.

Polypoid lesions of the colon frequently are associated with similar lesions of the rectum. In 2 of the 11 cases, a mass protruding from the rectum was one of the presenting symptoms. In 1 of the 2 cases, a diagnosis of hemorrhoids had been made and the true nature of the lesion had not been suspected.

DIAGNOSIS

In the diagnosis of polypoid lesions of the colon, the history is of great assistance. The bleeding

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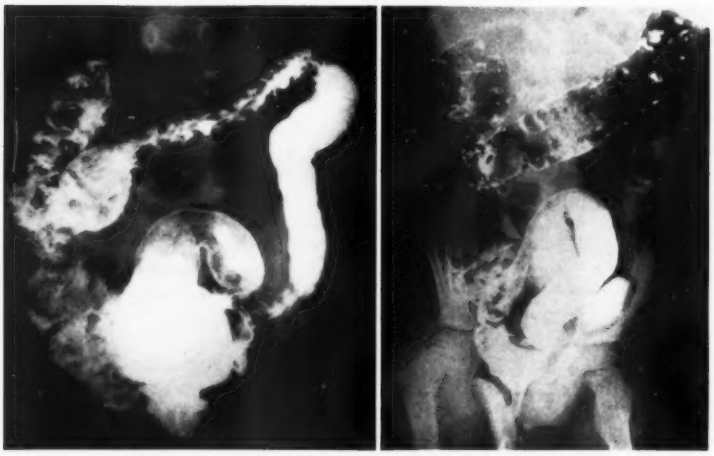

Fig. 1. a, left, Roentgenogram made after evacuation of the contrast (barium) enema, showing a widening in the transverse limb of the hepatic flexure caused by a large polypoid lesion in this segment; b, "double contrast" roentgenogram showing the globular polypoid lesion projecting into the lumen of the colon.

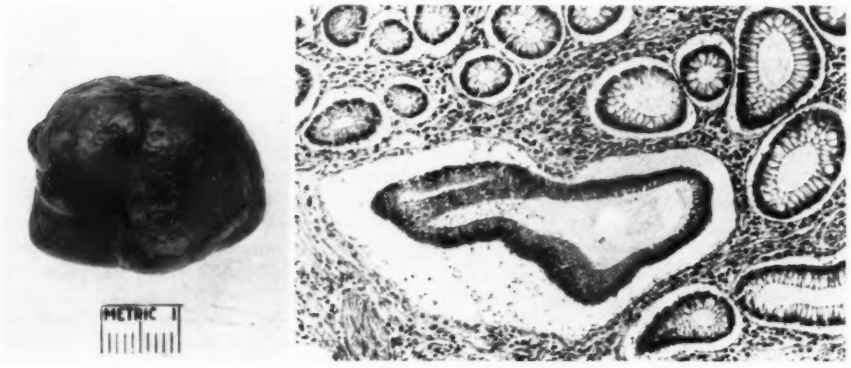

Fig. 2, left. Gross appearance of the polypoid lesion of the colon.
Fig. 3. Photomicrograph of polypoid lesion; adenocarcinoma, grade 1. × 85.

has certain characteristics. In the first place, the blood is fresh, that is, it is red in color. This indicates that the source of the bleeding is in the lower part of the gastrointestinal tract, certainly below the ileocecal valve. In the second place, the blood usually is on the outside of the stool and is not mixed with the stool as it usually is in cases in which the bleeding is due to lesions of the small intestine, such as Meckel's diverticulum. Finally, the bleeding is not associated with diarrhea, as it is in cases of chronic ulcerative colitis. On the contrary, the stools as a general rule are formed and the patient in many instances even may be constipated.

Symptoms other than bleeding from the intestine usually are strikingly absent. Pain, with or without tenderness, which may be present in cases of Meckel's diverticulum or colitis, is either slight in degree or absent. Patients who have polypoid lesions of the colon usually are well nourished or show no evidence of nutritional disturbance as a result of the disease. This is in striking contrast to the condition that obtains in chronic ulcerative colitis (2) or in amebic colitis (3), which is comparatively rare. Secondary anemia, which occurred only once in this series of cases, is the rule in colitis, especially in chronic ulcerative colitis of the bacterial type.

It should not be difficult to distinguish polypoid lesions of the colon from hemorrhoids. In cases in which a polypoid lesion also is present in the rectum and protrudes from the anus, the lesion at first may be mistaken for a hemorrhoid, but careful examination of the anus and rectum should permit one to make a correct diagnosis of the condition.

PROCTOSIGMOIDOSCOPY

In 6 of the 11 cases, polypoid lesions also were present in the rectum. The number of polypoid lesions revealed by proctosigmoidoscopy was as follows: 1 in 2 cases, 3 in 1 case, 4 in 1 case, 7 in 1 case and 8 in 1 case. The diagnosis of the polypoid lesions that were situated beyond the reach of the sigmoidoscope was made by roentgenologic examination. The discovery of polypoid lesions in the rectum is an indication rather than a contraindication for a roentgenologic search for polypoid lesions situated higher in the colon. If, in the 6 cases in which proctosigmoidoscopy revealed polypoid lesions in the rectum, we had confined our diagnostic and therapeutic efforts to these lesions in the rectum, we would have been guilty of gross mismanagement as the bleeding from the polypoid lesions of the colon would have continued.

ROENTGENOLOGIC EXAMINATION

Although the presence of polypoid lesions of the colon may be suspected from the clinical history, the diagnosis is made by roentgenologic examination. The number of polypoid lesions of the colon disclosed by roentgenologic examination was as follows: 1 in 9 cases and 3 in 2 cases.

In roentgenologic examinations of the large intestine, the fundamental maneuver is roentgenoscopic observation of the intestine while the contrast medium is being introduced as an enema and after it has been evacuated by defecation. Polypoid lesions are manifested as globular or ovoid filling defects in the cylindrical shadow of the bowel distended with the contrast medium (Figs. 1a and b). Since fecal masses can produce such filling defects, all fecal material must be removed from the intestine before the roentgenologic examination is begun.

In all essentials, the roentgenologic examination of the colon of infants and children is conducted in the same manner as it is in the case of adults, and the diagnostic principles are identical. At no time, however, is this examination a simple maneuver, and it can hardly be done without considerable inconvenience and discomfort to the patient. It is usually possible to make adults perceive that their own interests are being served by accepting the transient inconvenience and discomfort with fortitude; such an attitude cannot be expected of a child.

Polypoid lesions, it must be understood, do not deform the contours of the lumen of the intestine as constricting lesions do, but grow as soft, rounded or ovoid excrescences which project into the intestinal lumen. They may produce certain symptoms when they are less than 1 centimeter in diameter, but cause obstructive symptoms only when very large or when they lead to intussusception. When smaller in diameter than is the transverse diameter of the segment of intestine they occupy, they may easily be overlooked in the roentgenologic examination unless precautions are taken: (1) in the matter of preparing the intestine adequately for the roentgenologic examination, and (2) in the actual conduct of the examination.

A satisfactory roentgenologic examination of the colon is out of the question without preliminary removal of all gaseous, liquid, and solid fecal residue. There is no known way of accomplishing this except by the use of purgative drugs, and these must be chosen with the roentgenologic requirements in mind. The large intestine of a child is of proportionally greater length and caliber than is that of an adult. This is one of the circumstances which increases the difficulty of the roentgenologic examination of a child's colon; consequently, nothing in the scheme of preparing the colon should tend to exaggerate this disproportion in length and caliber. Saline purgative agents will act in this manner. They may assist effectively in removing solid fecal residue, but they do it by increasing the fluid bulk of the intestine, thus distending it. The usual net result is that the bowel is in less satisfactory condition for roentgenologic examination than it would have been had no attempt at purgation whatever been made.

To some extent, the same is true of cleansing enemas if enough of them are administered to reduce the fecal content of the intestine effectively. One, therefore, has to rely on the so called irritant cathartic drugs. The emodin and resinous cathartics and those containing phenolphthalein or mercurous chloride are effective enough, but their irritant action is too prolonged if they are administered in doses sufficiently large to promote purgation adequate for the purposes here in mind. The emollient cathartics such as liquid petrolatum and the vegetable oils are unsatisfactory for several reasons, the chief ones being that they are not intense enough in their action and

require too much time before they become effective.

Castor oil remains as the most satisfactory and at the same time the safest purgative agent for the purpose of preparing the large intestine for roentgenologic examination. The response that infants and children make to cathartic agents seems to be even more variable than that made by adults, so the proper dose is determined to some extent by inquiring how an individual child ordinarily responds to these agents. We have found that at least 15 cubic centimeters of castor oil is required for infants and 30 cubic centimeters for older children to promote adequate defecation. When the roentgenologic examination is to be done in the morning, the castor oil is administered the evening before, and the evening meal is withheld. The following morning, at least an hour before the roentgenologic examination is begun, a simple enema of not more than 250 cubic centimeters of physiologic salt solution is given to remove the last remaining fecal residue from the rectum and sigmoid colon. The usual morning meal may be given just before the time of the roentgenologic examination.

The first step in the roentgenologic examination is a preliminary survey of the abdominal field and any abnormal appearances are noted. The opaque enema is then administered under roentgenoscopic control, the contrast suspension being studiously observed as it makes the ascent into the upper segments of the colon, including the cecum. The internal topographic features of the bowel are studied by compressing one wall of the bowel upon the other with the palpating hand, and the patient is rotated from side to side on the roentgenoscopic table to bring the entire length of the large intestine into proper projection on the screen. This part of the examination should be done as quickly as possible. The patient becomes uncomfortable, to put it mildly, and the young patient will surely become the more unruly the longer the time of examination is extended; furthermore, it is found that the more quickly an enema is administered, the more effectively will it be evacuated when the opportunity is offered. As soon as the roentgenoscopic examination is completed, the child is taken to a toilet and is permitted, even urged, to empty the bowel of the enema as quickly and as completely as possible. The hope is that only enough of the opaque suspension will remain to give the mucous membrane a thin coat of it. Attempts to remove the opaque enema from the intestine by siphonage are usually fruitless, for only that segment actually occupied by the enema tip is emptied, and the patient thereby loses his stimulus for defecation. It is far better to take advantage of the normal physiologic processes in this connection. Not more than 5 minutes should be allowed the patient to effect this evacuation; however, if the time is extended much beyond this limit dehydration of the opaque suspension will take place, and the barium sulfate will tend to collect in clumps, thus destroying the desired painted effect. The patient is then returned for another roentgenoscopic examination, a special effort being directed at this time to make close scrutiny of the mucous membrane, particularly for small irregularities on its surface. Infants and children, as a rule, do not succeed in emptying the intestine enough for institution of a satisfactory double contrast technique. This technique is essentially a roentgenographic one, that is, roentgenograms are made after the intestine has been redistended with air or other inert gas, after the contrast enema has been evacuated. It is particularly useful in the roentgenographic demonstration of polypoid lesions (Fig. 1b). If evacuation has been incomplete, the bowel is redistended with air anyway, and the patient is given another opportunity to expel the enema, now composed of fluid and gas. The patient is returned to the roentgenoscopic room once more, and after a brief examination the intestine is insufflated for the last time and the double contrast roentgenograms are made. Stereoscopic roentgenograms are made by the use of the Potter diaphragm and it is our practice to make them in anteroposterior as well as in posteroanterior projections.

A word about the preparation of the opaque enema might be inserted here. A simple suspension of barium sulfate and water should never be injected into the large intestine. Efficient suspending agents are available, but we prefer a commercial preparation of barium sulfate which has a suspending agent already mixed into it and which requires only the addition of water to make the most satisfactory opaque enema known to us. No matter how prepared, the opaque enema should be heated to the temperature of the body before it is administered.

When it can be anticipated that a young patient will be unruly and difficult to handle in the roentgenoscopic room, it is well to quiet him with an effective dose of one of the soporific drugs. We have used pentobarbital sodium in doses of ¾ to 1½ grains (0.05 to 0.1 gm.) for this purpose with considerable satisfaction, and it is usually possible to examine even the most refractory child in this way. Here, however, as well as in connection with the preparation of a young patient for roentgenologic examination, complete co-operation of

pediatrician and roentgenologist is of paramount importance. Opportunities are abundant for the skill of the one to be nullified by the shortsightedness of the other.

TREATMENT

The treatment of polypoid lesions of the colon consists of transcolonic excision of the lesions or resection of the involved segment of the colon. The choice of operative procedure depends on the extent of the lesion (1). Umbilication of the wall of the colon usually indicates that the base of the lesion is broad or sessile. In cases in which this is present, segmental resection is indicated. In the majority of cases in which the patients are children, the polypoid lesions have a long pedicle. In such cases, transcolonic excision of the lesion seems sufficiently radical. This operation is performed as a single stage procedure.

In cases in which polypoid lesions of the colon have been disclosed by roentgenologic examination, it occasionally is difficult to locate the lesions by palpation when operation is performed. This is particularly true in cases in which all of the fecal material has not been removed from the intestine before the operation is started. During the past few years, the use of a "cold" light has proved of great value in locating such lesions. The operating room is darkened and the small light is placed behind the colon. This usually makes it easy to distinguish polypoid lesions from particles of fecal material. It permits one to see the small blood vessels of the lesion proper as well as those of the pedicle.

When transcolonic excision is performed, the colon is opened longitudinally on the antimesenteric border. After the polypoid lesion has been excised, the opening is closed by suturing the colon transversely.

As a rule, it is advisable to perform segmental resection in two stages. The first stage consists of resection of the involved segment and the formation of a double-barreled colonic stoma. At the second stage, the colonic stoma is closed. The septum first is crushed with clamps and the stoma subsequently is closed surgically. The closure also may be effected without crushing the septum with clamps.

Transcolonic excision was employed in 9 of the 11 cases. After the lesion had been excised, the pedicle was ligated or cauterized. Segmental resection was employed in 1 case. In this case, a side-to-side anastomosis was effected. In the remaining case, it was necessary to carry out a resection of the transverse colon and the descending colon.

PATHOLOGIC CHANGES

In most cases of polypoid lesions of the colon in which the patients are children, the lesions prove to be adenocarcinomas of a low grade of malignancy (Figs. 2 and 3). In a few of these cases, however, the lesion may be found to be a simple adenoma.

In 9 of the 11 cases, microscopic examination disclosed that the lesion was an adenocarcinoma, grade 1 or low grade 1[1]. In the 2 remaining cases, the lesion was classified as an adenoma. In 1 of these 2 remaining cases, the adenoma was severely inflamed.

Some authors have expressed the opinion that all adenomatous polypoid lesions are potentially malignant and that their removal, therefore, is indicated. Although polypoid lesions may be lipomatous, fibromatous, or angiomatous, we never have observed such lesions in the colon of children. Since the pathologic nature of a polypoid lesion cannot be determined except by microscopic examination, the removal of every polypoid lesion is indicated. Even if the lesion is benign, its presence is undesirable as it can cause intussusception, obstruction, or bleeding.

RESULTS

In all of the cases the patients survived the operation and were in good condition when they were dismissed from the hospital. In 1 case, the bleeding recurred 3 weeks after the operation. The patient in this case is still under observation at his home. It will be interesting to learn whether the recurrence of the bleeding is due to ulceration at the site of the operation or to the presence of other polypoid lesions.

SUMMARY

Polypoid lesions of the colon are an important cause of intestinal bleeding in cases in which the patients are children. Proctosigmoidoscopy will disclose the presence of polypoid lesions of the rectum and sigmoid colon. In cases in which polypoid lesions of the colon are situated beyond the reach of the sigmoidoscope, the diagnosis must be made by roentgenologic examination although the history usually is significant. In 6 of the 11

[1]In determining the malignancy of neoplasms by the method of Broders, all malignant neoplasms are divided into 4 grades—on the fundamental principle of cellular differentiation. In neoplasms that are classified as grade 1, at least 75 per cent of the cells are differentiated or partially differentiated, whereas, in neoplasms that are classified as grade 4, not more than 25 per cent of the cells are differentiated or partially differentiated.

Since this method of grading malignant neoplasms was devised, it has been found necessary to use the term "low grade 1" in designating the degree of malignancy of an adenocarcinoma that occurs in an adenoma. In cases in which the degree of malignancy is classified as "low grade 1," practically all of the cells if not differentiated are at least partially differentiated, thereby approaching but not completely imitating the differentiated cells of a strictly benign adenoma.

cases which form the basis of this paper, polypoid lesions also were present in the rectum. The discovery of polypoid lesions in the rectum is an indication rather than a contraindication for a roentgenologic search for polypoid lesions situated higher in the colon. The treatment consists of transcolonic excision of the polypoid lesions or resection of the involved segment of the colon. If all of the polypoid lesions can be found and removed, there is little likelihood that they will cause trouble in the future.

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THE USE OF METHEDRINE IN SURGICAL OPERATIONS

Clinical Study on an Effective Pressor Drug

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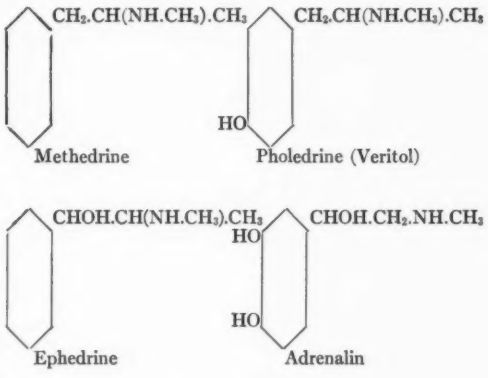
SINCE 1932 one of us has studied the use of pressor agents to counteract the serious falls of blood pressure, unaccompanied by severe reduction of blood volume, that often occur during major operations. The pressor effects of adrenalin, ephedrine and pholedrine (veritol) and others have been studied, but it has been found that generally none is effective for more than 30 to 45 minutes during operation, and repeated injections are often necessary.

Although the effect of an injection of 5 to 15 minims of liquor adrenalin (B.P.) on a patient with a low blood pressure is dramatic and the blood pressure climbs almost instantaneously to 200 to 300 millimeters mercury, the fall is just as precipitate. Similarly ephedrine, which for dependable results must be given intravenously, produces a sharp rise in blood pressure with short-lived effect, about 10 to 20 minutes and the blood pressure falls again. Until 1938, ephedrine was considered the best pressor drug available for counteracting the fall in blood pressure resulting from spinal anesthesia. From 1937 to 1942 one of us used pholedrine as a pressor agent to maintain the blood pressure in major operations. The results were better than with ephedrine in that pholedrine was effective intramuscularly as well as intravenously, but the effect of a single injection of the drug was rarely more than 45 minutes. Repeated injections were often necessary. One of us remarked of pholedrine: "Its only weakness is that its effect is not long enough (although it has yet to be shown that any other drugs are better in this respect). May one look for a drug that will restore and maintain a moderate level of blood pressure for two hours or more?" (Dodd, 1939).

We believe that this ideal pressor agent has been found and proved in the recently available drug methedrine.[1] This was examined in a search for an effective pressor agent with a reliable and sustained action that could be administered by any route under average clinical conditions. Methedrine was chosen on account of its close chemical relationship to pholedrine.



SURGICAL SHOCK

Surgical shock is so serious that, once established, the outlook is grave. Therefore, every surgical team aims to prevent shock and not to wait until it supervenes and then treat it with transfusions and blood pressure raising drugs, which are probably useless once shock is established. Lord Moynihan said that we should not only make surgery safe for the patient, but we should make the patient safe for surgery. In the light of our experience we think that no major operation should be performed especially under spinal anesthesia, without serial recordings of the blood pressure at least every 10 minutes and preferably every 3 to 5 minutes. We have found that the feel of the pulse is misleading as a guide to the blood pressure. While it will give a rough estimate of the patient's cardiovascular system, we have observed patients repeatedly with a good and regular pulse and the blood pressure between 60 and 80 millimeters systolic or their pulse pressure 10 millimeters or less.

It is taught that as the blood pressure falls the pulse rate goes up and that a progressive rise in

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[1]Methedrine is the Burroughs Wellcome & Co. trademark for N-methylamphetamine, the hydrochloride of which was used in this study.

rate is usually a bad sign. In our readings this is by no means true. We have often observed a falling blood pressure to coincide with a falling pulse rate, for example systolic 60 millimeters, pulse 40 to 50. The pulse rate alters during an operation in response to the anesthetic or the surgical procedure. The clinical signs of shock at operation are described as pallor, sweating, coldness of the skin, falling blood pressure, rising pulse rate, dilated pupils, and sighing respiration. Some of these (respiration, pupils, sweating, and pallor) are modified by the premedication (morphine, scopolamine, atropine), the anesthetic, and the temperature and humidity of the operating theater, and therefore, are not reliable signs of shock. From a study of a number of operations we consider that incipient shock can best be detected by following the blood pressure and observing the color and temperature of the patient's arm. We regard a fall in blood pressure below 80 millimeters systolic or a pulse pressure of less than 10 millimeters and cold extremities (nose, ears. limbs) as signs of impending shock. A pressor drug should be given to restore the blood pressure, or a plasma transfusion if there has been a considerable fluid loss. Patients with a low blood pressure and impending shock often have collapsed veins. An efficient pressor drug should, therefore, be effective intramuscularly, as valuable time may be lost in entering a vein. We have found that methedrine has this advantage: it acts intramuscularly in approximately 5 minutes and gradually restores fallen blood pressure to normal in 15 to 18 minutes. We think that this consistent, gradual action is one of its assets.

It is a debatable point to what level the blood pressure should be allowed to fall and how long it may remain down before attempting to raise it to normal levels. Hewer (1943) gives a guide. He states that a patient should not be left on the operating table for more than 20 minutes with a systolic pressure below 80 millimeters, or a diastolic pressure of less than 60 millimeters; that if this time is appreciably exceeded death is extremely probable within 48 hours. A very low blood pressure is inadequate to sustain the vital processes and if prolonged may lead to irreversible shock (McMichael, 1942).

Independently we adopted this as one indication for administering methedrine. We believed that blood pressure below 80 millimeters for any length of time would deprive the heart, brain, and other vital centers of blood and hence of oxygen and nourishment and thus slow recovery, impair healing power and predispose to postoperative complications. We question to what extent are such postoperative complications as repeated vomiting, dilatation of the stomach, ileus, postoperative pneumonia, embolism, and suppression of urine, due to a fall of blood pressure during and after operation, part of the manifestations of shock. The blame is usually, and possibly unjustly, put on the anesthetic. In a series of 130 operations followed by us, and in which falls of blood pressure were checked after about 20 minutes, we observed postoperative complications in only 2 of them; these were suppression of urine and a pulmonary embolus. There were 3 deaths after operation; 1 from reactionary hemorrhage after prostatectomy, 1 from sepsis after resection of the rectum, and 1 from cardiac failure after amputation for a neglected secondarily infected tuberculous knee joint. The patients were elderly and bad operation risks. From our studies it is our opinion that by maintaining the blood pressure at normal levels during operations, the incidence of postoperative complications and funerals in our series has been reduced. This opinion is borne out by the work of Papper and associates (1943), which appeared after ours was completed. They noted that a significant fall in blood pressure occurred in 70 per cent of a series of 243 patients operated on under spinal anesthesia, and that complications, during and after operation, were greater in this group than in the remaining 30 per cent in which the blood pressure fell only slightly or not at all. In the former group the incidence of complications (not including nausea) was 28 per cent, and in the latter only 13 per cent. There were 7 cases of syncope in the group in which the blood pressure fell and none in the group in which it was maintained.

In average surgical practice, blood pressures are sometimes determined at operation in the case of poor risk patients but we have observed that the behavior of a patient during operation cannot be predicted. We have seen elderly and poor risk patients survive such major operations as splenectomy, or a complicated gastric resection lasting 2 hours, with hardly any fall in blood pressure, yet young and moderately fit patients have shown a pronounced fall in blood pressure following such relatively minor procedures as ligature and injection of varicose veins, orchidectomy and repair of hernias. We do make a plea, therefore, for the routine repeated determination of blood pressure in all major operations; the request must come from surgeons convinced of its service to patients.

PHARMACOLOGY OF METHEDRINE

In man moderate doses of methedrine act as a pressor agent by vasoconstriction of the peri-

pheral vessels; in larger doses it acts directly on the heart. In doses of 15 milligrams or more it causes an increase in the rate and depth of respiration. Administered by mouth or parenterally it acts as a cortical stimulant like amphetamine, and produces a state of euphoria and increased mental clarity. We have observed that in doses of 15 milligrams or more parenterally it is capable of abolishing the sedative effect of 1/6 grain of morphine and 1/150 grain of scopolamine. Its analeptic action as tested on mice is one and a half times that of amphetamine (Trevan, 1938). In the normal person a rise of blood pressure (e.g. from 120 mm. to 180 mm. systolic), palpitations, restlessness, sleeplessness, tachycardia, tremor, and dryness of the throat are observable in doses of 60 to 70 milligrams parenterally. Surgical patients with a low blood pressure have tolerated these amounts without any untoward effects. The acute toxicity as tested on the rat is 1/8 to 1/10 that of ephedrine or pholedrine.

The pressor activity of methedrine on the pithed cat was rather disappointing (Trevan, 1938), nevertheless we decided to evaluate the drug under truly clinical conditions.

ANALYSIS OF 130 OBSERVED OPERATIONS
(Serial blood pressure and pulse recorded)

	Cases	Methedrine used	Methedrine not used
Cholecystectomy and choledochostomy	11	8	3
Gastrectomy and gastroenterostomy	17	6	11
Excision of colon and rectum	4	3	1
Mastectomy for carcinoma (Halsted)	5	1	4
Laparotomy and appendicectomy	16	4	12
Hernial repair	16	11	5
Cervical sympathectomy and excision of cervical rib	7	2	5
Operations on kidney for stone or carcinoma	7	4	3
Operations on testicle	7	4	3
Operations on ureter and bladder	4	2	2
Ligature and injection of varicose veins	17	4	13
Thyroidectomy	5	1	4
Splenectomy	1	—	1
Hemorrhoidectomy	2	1	1
Prostatectomy	3	—	3
Hysterectomy	1	1	—
Amputation	1	1	—
Miscellaneous	7	2	5
Totals	130	54	76

CONDITIONS OF USE OF METHEDRINE

Blood pressures and pulse rates were recorded at intervals of 3 to 5 minutes in 130 operations, many of them major. Details and times of the operative procedures were noted. In 54 cases the blood pressure dropped to 80 millimeters or less systolic or the pulse pressure to 10 millimeters or less. After 20 minutes at these low levels (actually natural recovery seldom occurred), we considered that these patients needed a pressor agent and methedrine was injected in the dosage to be mentioned—no other agents or stimulants such as carbon dioxide, saline, blood transfusion, were given. Blood pressure falls were often observed after incising the peritoneum, handling the viscera, pulling on the mesentery, exploring the bile ducts, and also in operations on the kidney, testicles, and gall bladder. We also recorded a temporary fall in blood pressure after the injection of varicose veins.

The blood pressure and pulse rate are also affected by the anesthetic used. Thus spinal anesthesia commonly results in a fall of blood pressure to 90 to 80 millimeters systolic; ether and gas if given rapidly cause an increase in pulse rate.

Surgical experience shows that low blood pressure does recover naturally, but how soon? We observed one debilitated patient (? gallstones) in whom recovery would ordinarily be expected to be slow and possibly complicated. During the laparotomy (Case 3), the blood pressure fell to 60/40 millimeters and showed no signs of recovery after 1½ hours. After this we did not feel justified in leaving her with so low a blood pressure and methedrine was given (15 mgm. intramuscularly + 15 mgm. intravenously). She responded immediately. In 2 minutes the blood pressure rose to 105/60 mm. and in 10 minutes it was at its preoperative level, and with small fluctuations was maintained for at least 3¼ hours, when observations were discontinued. She recovered uneventfully.

ANESTHETICS USED

The anesthetics used in this study included: (a) *spinal* 1:1,500 to 1:2,000 nupercaine, either alone or supplemented by gas-oxygen, gas-oxygen-ether, or by pentothal; (b) *general anesthetics* such as nitrous oxide gas and oxygen, nitrous oxide gas-oxygen-ether, open ether, and trichlorethylene; (c) *local anesthesia*, with amethocaine 1:1,000 either alone or supplemented by nitrous oxide gas-oxygen, ether, trichlorethylene or pentothal; (d) *pentothal* alone or with nitrous oxide gas-oxygen, ether, or trichlorethylene and oxygen.

After the injection of a spinal anesthetic the blood pressure usually falls rapidly to 80 millimeters systolic, but this fall is inconsistent, and the blood pressure may not drop more than 10 to

20 millimeters systolic. This fall in blood pressure is regarded by some as a type of secondary shock (Schuberth, 1938). There has been a considerable vogue for giving pressor drugs just before the spinal anesthetic to prevent the fall in blood pressure. We refrained from giving methedrine as a routine preferring to wait and see if the blood pressure fell to 80 millimeters systolic or less, and if it did so to give it a chance to recover spontaneously before giving methedrine. We believe that this is important because the administration of a powerful pressor agent to a patient with a normal blood pressure may result in an abnormally high rise, which may increase hemorrhage from the operation wound, impoverishing the patient and hindering the surgeon. An abnormally high blood pressure is dangerous in a patient with myocardial disease, hypertension or arteriosclerosis.

ADMINISTRATION

We found methedrine effective as a pressor agent when administered subcutaneously, intramuscularly, and intravenously. Since absorption from the subcutaneous tissues is slow in circulatory failure the intramuscular and intravenous routes were used. As an intramuscular injection was effective within approximately 5 minutes, this was given in preference to an intravenous injection. Provided a vein could be readily entered then the most rapid restoration of a profound fall in blood pressure followed the intravenous route. An intravenous injection produces an almost instantaneous response, while an intramuscular one, acting more slowly, has an action that is prolonged for several hours. Whenever an intravenous injection was given a "sustaining depôt" dose was given intramuscularly at the same time. A total of 68 injections were given to 54 patients, 51 intramuscularly and 17 intravenously; of the latter, 14 were given simultaneously with intramuscular injections.

DOSAGE

Single dose. The dose for a single intramuscular injection of methedrine varied from 15 to 30 milligrams; for a single intravenous injection from 10 to 20 milligrams. Naturally it depended upon the patient's condition. In 44 of the 54 cases studied, i.e., 81 per cent, a single injection was sufficient to restore the blood pressure to normal limits.

Minor operations. If the blood pressure fell during hernia operations under spinal anesthesia, or during the ligature and injection of varicose veins, smaller intramuscular doses of methedrine were adequate as the patients responded readily; with incorrect large doses the blood pressure may easily rise to high levels. When the systolic pressure dropped to 80 millimeters or the pulse pressure to 15 to 10 millimeters an intramuscular injection of 15 to 20 milligrams was generally adequate. This amount was increased to 25 milligrams if the systolic pressure fell below 80 millimeters. Intravenous injection is not as a rule necessary.

Major operations. In major operations in which the blood pressure fell below 80 millimeters the dosage of methedrine was 25 to 30 milligrams, given either intramuscularly in a single dose, or as a combined injection of 10 to 15 milligrams intravenously and 15 to 20 milligrams intramuscularly. When the blood pressure fell to 60 millimeters to 40 millimeters systolic, or below, then 15 to 20 milligrams was given intramuscularly and 15 to 20 milligrams intravenously. Only 2 patients received the maximum single dose of 20 milligrams intramuscularly plus 20 milligrams intravenously. Each case was critically evaluated in the light of the patient's age, physique, blood pressure, color, temperature, and respiration. Patients with a low blood pressure and in a state of impending shock need larger doses.

Multiple injections. In 10 of our cases more than one injection was given, although on an average 20 minutes was always allowed for the first dose to act. If the response was not sufficient after this time a second injection was given. Subsequent experience revealed that the first dose was too small in 4 of the 10 cases, leaving 6 of 54 who really needed more than one injection. Seven patients were given 2 injections to restore the blood pressure to normal, although in 4 of these the dose was too cautious, leaving 3 who really required more than one injection. In 3 patients 3 injections were given; 1 was a radical mastectomy, in which small doses were deliberately given to keep the pressure at low normal levels and to minimize the risk of hemorrhage from the large wound.

Although the maximum single dose given was a combined injection of 20 milligrams intramuscularly and 20 milligrams intravenously—that is 40 milligrams in all—the maximum total dosage received by any one patient was 75 milligrams given in 3 intramuscular injections over a period of 1½ hours during a plastic operation for hydronephrosis. Other patients received total doses of 70, 65, 55, and 50 milligrams respectively. No untoward effects were noted. All recovered, 3 uneventfully, one with moderate postoperative vomiting.

In our early administrations, mistakes in dosage were made. In the first case too many small doses of 10 milligrams were given; one large dose of 30 milligrams would have been more effective (Case 1). In another case (Case 36) a large dose (30 milligrams) was given to a patient whose blood pressure had fallen to only 90 millimeters. This was given intramuscularly, but some of it probably entered a small vessel, as the blood pressure shot up to 240 millimeters systolic in under 15 minutes. In only 3 patients did the blood pressure rise to more than 30 millimeters above the preoperative systolic pressure. This occurred in the early cases before the dosage had been learned.

TIME TAKEN FOR METHEDRINE TO ACT

Intravenously. After an intravenous injection the blood pressure began to rise within a minute. The time taken for the maximum pressure to develop depended upon the dose and varied from individual to individual. The shortest time was 2 minutes and the longest 10, with an average of 5½ minutes.

Intramuscularly. An intramuscular dose of 15 to 30 milligrams produced a measurable rise of blood pressure in from 2 to 10 minutes, with an average of 4 minutes. The peak rise after an intramuscular injection was reached in from 4 to 38 minutes, with an average of 18 minutes.

DURATION OF ACTION OF METHEDRINE

The duration of action of an intravenous dose of methedrine is variable, from half an hour to several hours.

A carefully calculated intramuscular dose or a combined intramuscular-intravenous dose produces an effect which lasts for many hours in most patients. In 44 of 54 cases a single intramuscular or combined intramuscular-intravenous injection permanently restored the systolic blood pressure to its preoperative level or to within 90 per cent of it. This pressure was sustained throughout the operation and for recorded periods of from half an hour to over 48 hours after.

Nine patients required more than one injection; in all the blood pressure was sustained throughout the operation and for several hours afterward. In only 1 case of 54 did the methedrine fail to restore and maintain the blood pressure to 100 millimeters systolic.

EVALUATION OF PRESSOR ACTION OF METHEDRINE

Systolic pressure. Methedrine has been found to exert an effective gradual and sustained pressor action in surgical patients with a low blood pressure; only 1 patient failed to respond to the drug. In 97 per cent of the cases studied the blood pressure was restored to normal levels in a period varying from 2 to 18 minutes. In a patient with a low blood pressure who has received an adequate intramuscular-intravenous injection of methedrine, a measurable rise in blood pressure occurs in 1 minute, reaches a maximum in 5 to 15 minutes, and is sustained over a period of several hours after the operation (Fig. 1). There is no precipitate rise and fall, such as occurs with ephedrine (Fig. 3) or pholedrine. The blood pressure curve is of a plateau type and once the blood pressure is restored it is maintained. After an intramuscular injection (Fig. 2) the rise in blood pressure is more gradual, but the maximum pressure is of the same order as after an intravenous injection, and the action is usually more prolonged.

The systolic pressure after the administration of methedrine rarely rises above the preoperative level unless an overdose is given. In only 3 of our cases did it rise more than 30 millimeters above the preoperative level; in any case it quickly settles down to the normal level, or within 90 per cent of it.

The average preoperative blood pressure of our 54 patients was 137 millimeters systolic; during the operation the average figure to which it dropped was 66 millimeters systolic. This rose to an average of 133 millimeters in an average time of 18 minutes after the methedrine was given. The average figure to which it finally settled was 124 millimeters, measured after periods from 30 minutes to 48 hours after operation. This corresponds to a permanent rise to 91 per cent of the preoperative level. Repeated observations after operation showed that the blood pressure was maintained.

One injection was adequate in 44, or 81 per cent, of the patients, more than one injection was given in 17 per cent, and 1 patient, or 2 per cent, failed to respond. The blood pressure was restored to normal levels in 52 out of 54, or 97 per cent, of the cases.

Pulse pressure. The pulse pressure was increased from an average of 14 millimeters, when the methedrine was administered, to a maximum of 55 millimeters. The final value was 40 millimeters.

Pulse rate. The effect on the pulse rate was variable. Generally there was an increase of 15 beats to the minute, although in 6 patients there was a fall of an average of 12. In 3 cases the pulse rate was unaffected. After methedrine was given to pulseless and collapsed patients the pulse became full and bounding. Both the anesthetic and

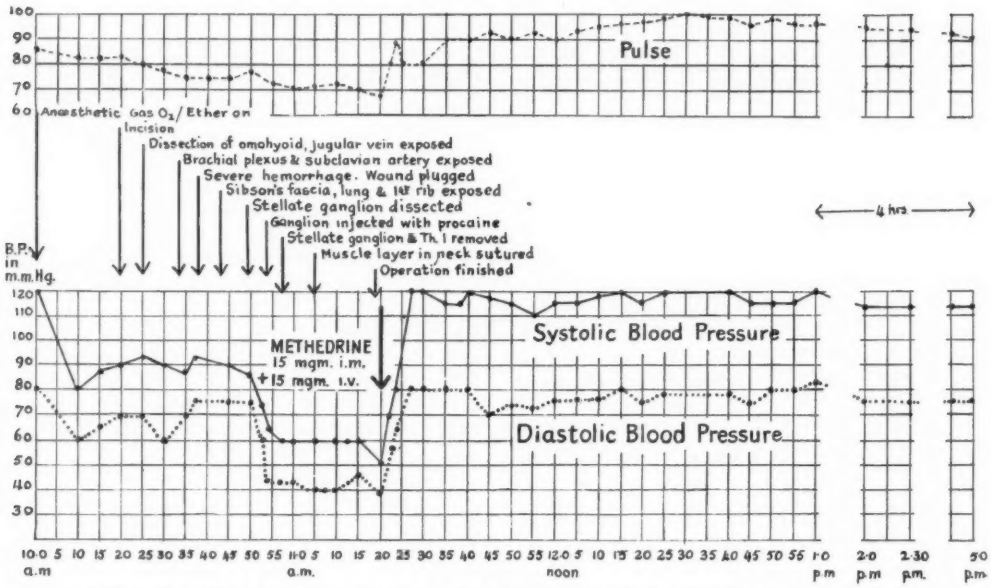

Fig. 1. Effect of combined intravenous-intramuscular injection of methedrine on blood pressure and pulse rate during a cervical sympathectomy. Only one injection was necessary.

the surgical trauma affect the pulse rate, so that it is often impossible to get a clear picture of the effect of the drug alone.

Respiration. This was not recorded routinely, but it was observed that methedrine increased the rate and depth of respiration of patients who were in a poor condition and whose respiration was shallow.

Repeated doses. Repeated doses are effective. Our considered opinion is that the best result follows a carefully assessed and adequate dose given in one injection.

CONSTITUTIONAL REACTIONS

Apart from extra systoles in 3 patients nothing clinically abnormal was noted in those who had received methedrine. The effect of the anesthetic cannot be excluded as extra systoles were also observed in patients under ether who had not received methedrine.

In the unanesthetized person methedrine acts as a cortical stimulant and produces a sensation of euphoria like amphetamine (Golla, et al., 1940). This effect was not noticed in our patients, presumably being annulled by the premedication, anesthetic, and postoperative morphine, which was given every 4 hours after major operations. Three of 54 patients became excited or delirious after operation; 2 were elderly patients who had had hernia operations, and their behavior was not unexpected.

When one of the authors (F. P.) received 70 milligrams of methedrine intramuscularly in divided doses over 5 hours the blood pressure rose from 130 millimeters systolic to 180 millimeters, and vomiting, cortical stimulation, persistent tachycardia, and severe palpitations were experienced. The acute symptoms lasted 24 hours and the tachycardia and palpitations for several days. We suggest, therefore, caution in giving total doses of more than say 60 milligrams although this dose appears to be tolerated well by patients with a low blood pressure. Pressor agents are potent drugs; they should never be given without reading the blood pressure before each injection. Overdosage may be disastrous in a patient with myocardial and coronary disease, hypertension, arteriosclerosis, or hyperthyroidism. The possibility of a cerebral accident in an elderly patient with hypertension or arteriosclerosis must be borne in mind. One of us (H. D.) has experienced them on three occasions outside this study.

ELECTROCARDIOGRAMS

Electrocardiograms were taken in 3 patients, 2 of whom received the maximum single dose of 40 milligrams of methedrine. No significant changes were observed. In 1 case there was a tem-

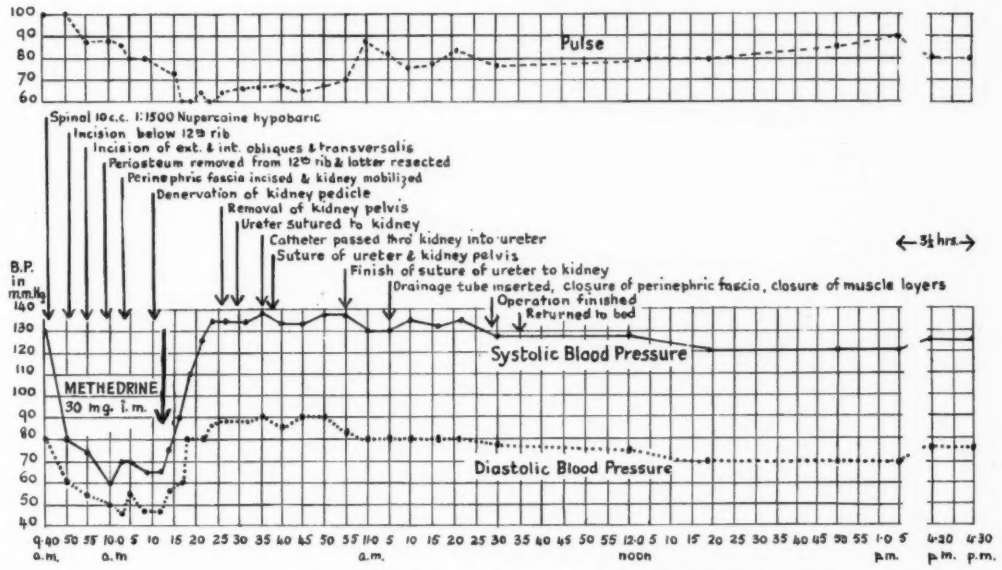
Pulse
Spinal 10 c.c. 1:1500 Nupercaine hypobaric
Incision below 12th rib
Incision of ext. & int. obliques & transversalis
Periosteum removed from 12th rib & latter resected
Perinephric fascia incised & kidney mobilized
Denervation of kidney pedicle
Removal of kidney pelvis
Ureter sutured to kidney
Catheter passed thro' kidney into ureter
Suture of ureter & kidney pelvis
Finish of suture of ureter to kidney
Drainage tube inserted, closure of perinephric fascia, closure of muscle layers
Operation finished
Returned to bed
← 3½ hrs. →
B.P. in m.m.Hg
METHEDRINE 30 mg. i.m.
Systolic Blood Pressure
Diastolic Blood Pressure
a.m.
noon
p.m.

Fig. 2. Effect of an intramuscular injection of methedrine on blood pressure and pulse rate during renal sympathectomy and pyelectomy. One injection was sufficient.

porary shortening of the *RST* segment in lead 2, isoelectric *T* and *P* waves in lead 1, and upward displacement of the *ST* segment in leads 2 and 3. These changes were transient and we attach no significance to them. The clinical significance of some abnormal electrocardiographic findings is not certain enough to deny patients the benefit of this drug. Moreover anesthetics and surgical trauma may produce temporary changes in the electrocardiogram and their effect cannot be excluded when testing a drug at operation (Kurtz et al., 1936; Brechling and Hansen, 1939).

The electrocardiogram of one of the authors (F. P.) taken 24 hours after the intramuscular injection of 70 milligrams of methedrine was normal.

Many drugs used in emergencies, such as adrenalin, digitalis, atropine, and ergometrine may produce temporary changes in the electrocardiogram (Graybiel and White, 1941; Hartwell et al., 1942).

COMPARISON WITH OTHER PRESSOR AGENTS

One of us (Dodd, 1939, 1940, 1942) has had the opportunity of comparing clinically the pressor effects of methedrine with those of adrenalin, ephedrine, and pholedrine (veritol). Their relative clinical value as pressor agents can be seen by comparing Figures 1 and 2 with Figure 3. We consider that the pressor effect of methedrine is superior to that of these drugs because: (a) it does not produce a precipitate rise, nor is it followed by sharp falls of blood pressure; (b) the blood pressure is gradually restored to and maintained at its preoperative level or within 90 per cent of it for several hours; the duration of effect of adrenalin, ephedrine, and pholedrine is not more than 30 to 45 minutes; (c) one injection is usually sufficient.

We have not had the opportunity of testing *s*-methylisothiourea, neosynephrin, paredrine and phedracin, but a survey of the literature reveals that they have drawbacks. Thus *s*-methylisothiourea, recently reported on by Smirk and McGeorge (1942), can only be given slowly by the intravenous route, and the single clinical report on it relates only to its use in spinal anesthesia; moreover there is no account of what happened after the operations. The duration of action of a single dose of neosynephrin is only ½ to ¾ hour and several injections (from 2 to 6, and in 1 case 23) are often necessary to raise and maintain the blood pressure (Johnson, 1937; Lorhan and Oliverio, 1938; Bittrich, 1939; Brunner and de Takats, 1939; Silvers and Leonard, 1940; Lorhan and Lalich, 1940). Thus in a series of cases reported by Bittrich (1939) 63 per cent of the patients treated with neosynephrin required from

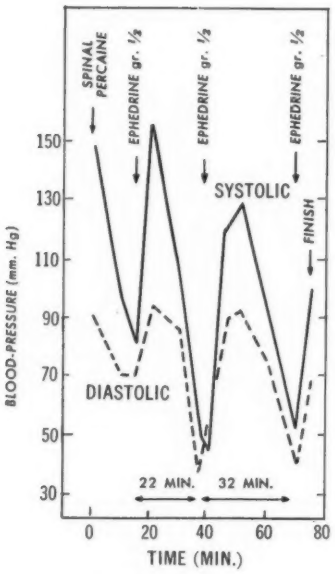

Fig. 3. Effect of intravenous injections of ephedrine on blood pressure during radical excision of breast carcinoma. (From *Lancet*, 1940, Feb. 24, p. 359.)

2 to 6 injections to maintain the blood pressure during operations under spinal anesthesia. Neosynephrin may cause partial heart block, as a result of excessive slowing of the pulse, for example, to 30 beats per minute (Brunner and de Takats, 1939).

Paredrine may produce an excessive rise in blood pressure (Loman et al., 1939; Altschule and Gilman, 1939) and persistent coupling of heart beats, systolic murmurs and splitting of heart sounds (Abbott and Henry, 1937). Its duration of action appears to be longer than that of the pressor drugs previously mentioned, but not as long as that of methedrine.

Phedracine like neosynephrin slows the pulse, and must be given intravenously to obtain the maximum effect. It also apparently produces unpleasant side effects, e.g. desire to micturate, feeling of coldness down neck and spine and a sensation of tightness across the head (Jones and Wilson, 1938). In the doses given by Jones and Wilson (1938) phedracine sometimes produced an excessive rise in blood pressure.

We have not had the opportunity of using methedrine in cases of traumatic shock, but we think that its sustained effect makes it worthy of trial in such cases.

CASE RECORDS

The following case histories illustrate the values of methedrine as a pressor agent in operations.

CASE 3. M. M., female, aged 45 years, had a laparotomy, and operation lasted 1¼ hours. Her condition was poor; she was thin and emaciated. Her preoperative blood pressure was 120/80 millimeters. The anesthesia was local with amethocaine, followed by nitrous oxide gas-oxygen-ether. After exploration of the abdominal organs, the blood pressure fell to 80/55 millimeters, and after appendicectomy and suture of the filmy peritoneum to 55/50 millimeters. It remained between 55/40 millimeters and 60/50 millimeters for 1½ hours. There were no signs of natural recovery. Methedrine, 15 milligrams, was given intravenously plus 15 milligrams intramuscularly. In 2 minutes the blood pressure rose to 105/60; in 10 minutes was 115/70 millimeters and was maintained between 110/70 and 120/80 millimeters for at least 3¼ hours. The pulse rate rose from 70 to a maximum of 100. Recovery was uneventful.

CASE 7. A. L., male, aged 59 years, had a partial gastrectomy and cholecystectomy. The anesthesia was spinal with nupercaine. Duration was 2 hours. The preoperative blood pressure was 140/80 millimeters. Ten minutes after the spinal anesthesia the blood pressure fell to 80/60 millimeters and during the next half hour fell progressively to 40/30 millimeters. Methedrine, 15 milligrams, was given intramuscularly and 15 milligrams intravenously. In 3 minutes the pressure was 100/65 millimeters; in 25 minutes 140/80 millimeters, then fell during the next ¾ hour to 120/80 millimeters and was at this level until the end of the operation. Pulse rate was raised from 80 to 95 per minute. Recovery was uneventful.

CASE 10. J. E., male, aged 63 years, had a Bassini repair of a right inguinal hernia. Operation lasted 1¼ hours. Anesthesia was produced by local infiltration with procaine. The preoperative blood pressure was 140/80 millimeters. After 25 minutes the blood pressure was 80/75 millimeters. A second direct sac was discovered and after difficulty the bladder was freed from it. Ten minutes later the blood pressure dropped to 50/40 millimeters. Methedrine, 15 milligrams, was administered intravenously and 15 milligrams intramuscularly. In 5 minutes the pressure rose to 115/70 millimeters and the next 15 minutes climbed to 130/70 millimeters and finally to 135/80 millimeters. It settled to 130/70 millimeters by the end of the operation and was at this level 5 hours later. Pulse rate rose from 48 to 54 per minute. Patient recovered.

CASE 25. W. S., female, aged 47 years. A cholecystectomy and drainage of common bile duct required 1¾ hours. The preoperative blood pressure was 135/95 millimeters. Anesthesia was spinal with 1:1500 nupercaine. While the rectus muscle was being separated the blood pressure fell to 50/35 millimeters and for following 10 minutes was too low to record. Methedrine, 30 milligrams, was given intramuscularly. There was a rise to 30 millimeters systolic in 2 minutes and to 100/60 millimeters in 15 minutes, which was maintained for 1 hour. Further 15 milligrams methedrine was injected intramuscularly and the blood pressure slowly rose to 120/80 millimeters and was sustained there for 4 hours. The pulse rate was raised temporarily from 80 to 96. The effect of methedrine lasted at least 5¼ hours. Patient recovered.

CASE 31. D. A., female, aged 33 years, had a cervical sympathectomy for paralysis agitans. Operation lasted 1¼ hours. The anesthetic was nitrous oxide gas-oxygen-ether. The preoperative blood pressure was 120/80 millimeters. Ten minutes after the incision, blood pressure fell to 80/75 millimeters. Thirty-five minutes later the stellate ganglion

TABLE I.—SUMMARY OF CASES SHOWING EFFECT OF METHEDRINE ON BLOOD PRESSURE AND PULSE RATE

No., Sex, Age	Operation	Anesthetic	Dose in mgm.	Blood pressure in mm.				Effect on pulse rate per min.	Time taken for methedrine to act—min.	Time to produce maximum rise in blood pressure—min.	Duration of action and blood pressure after this time
				Pre-operative blood pressure	Blood pressure just before giving methedrine	Maximum blood pressure after methedrine	Final blood pressure				
1 M,76	Excision of rectum	Spinal nupercaine	3x10 i.m.+2x10 i.v.	150/ 90	0	120/ 70	?	+20	2	5	30 min. if given i.v. 80/60 mm.
2 F,39	Laparotomy	Spinal nupercaine	15 i.v.+15 i.m.	120/ 75	70/ 50	125/ 80	110/ 65	+ 4	1	10	At least 2 hr. 110/65 mm.
3 F,45	Laparotomy	Local +ether-gas-oxygen	15 i.v.+15 i.m.	120/ 80	60/ 50	115/ 70	110/ 70	+30	1	11	At least 3 hr. 10 min. 110/70 mm.
4 F, 62	Gastroenterostomy	Pentothal+ ether-gas-oxygen	10 i.v.+15 i.m.	120/ 80	70/ 55	120/ 85	105/ 70	+15	1	5	At least 1 hr. 10 min. 100/70 mm.
5 F, 56	Cholecystectomy	Spinal nupercaine +pentothal	30 i.m.+15 i.v. +10 i.m.	150/ 90	50/ 45	150/100	150/ 85	+12	5	23	At least 5 hr. 15 min. 150/85 mm.
6 M,45	Cholecystectomy	Spinal nupercaine +pentothal	20 i.v.+20 i.m.	130/ 80	60/ 55	150/ 80	115/ 65	+12	2	17	At least 4 hr. 115/65 mm.
7 M,59	Cholecystectomy +gastrectomy	Spinal nupercaine	15 i.m.+15 i.v.	140/ 80	40/ 30	140/ 80	120/ 70	+15	1	28	At least 2 hr. 120/70 mm.
8 M,45	Hernia	Spinal nupercaine +pentothal	20 i.v.+20 i.m.	160/ 90	60/ 50	180/100	135/ 85	−22	1	9	At least 4 hr. 15 min. 135/85 mm.
9 M,50	Hernia	Spinal nupercaine	10 i.v.+15 i.v.	130/ 70	60/ 50	145/ 90	110/ 70	−10	1	30	At least 2½ hr. 110/70 mm.
10 M,63	Hernia	Local procaine	15 i.v.+15 i.m.	140/ 80	50/ 40	135/ 75	130/ 70	+10	1	23	At least 1¼ hr. 130/70 mm.
11 M,54	Hernia	Spinal nupercaine	25 i.m.	140/ 90	70/ 60	130/ 80	125/75	+ 8	2	18	At least 1¾ hr. 125/75 mm.
12 M,77	Hernia	Local procaine +pentothal	20 i.m.+20 i.m.	150/100	80/ 70	140/ 80	130/70	+16	6	34	At least 1¼ hr. 130/70 mm.
13 M,56	Hernia	Spinal nupercaine	25 i.m.	180/ 90	60/ 50	150/ 80	150/ 80	+10	8	27	At least 2½ hr. 150/80 mm.
14 F,33	Hernia	Spinal nupercaine	20 i.m.	140/ 80	90/ 70	140/ 85	140/ 90	+20	2	20	At least 2¼ hr. 140/90 mm.
15 M,51	Hernia	Spinal nupercaine	20 i.m.	180/100	70/ 60	160/105	130/ 80	+10	2	20	At least 2 hr. 130/80 mm.
16 M,57	Hernia	Spinal nupercaine	25 i.m.	120/ 80	75/ 55	180/100	120/ 80	0	3	25	At least 3½ hr. 120/80 mm.
17 M,40	Hydrocele	Local procaine	20 i.m.	100/ 70	90/ 80	130/ 90	100/ 70	+10	4	18	At least 1½ hr. 100/70 mm.
18 M,32	Orchidectomy	Pentothal open ether	15 i.m.	140/ 70	95/ 85	140/ 80	135/ 80	+ 8	3	13	At least 2¼ hr. 135/80 mm.
19 M,35	Varicose veins	Pentothal	15 i.m.	120/ 70	100/ 90	135/ 70	120/ 70	+10	2	6	At least 1 hr. 120/70 mm.
20 F,54	Varicose veins	Pentothal+ gas-Trilene-oxygen	20 i.m.	130/ 90	85/ 75	140/100	130/ 90	+36	3	7	At least 1¼ hr. 130/90 mm.
21 M,42	Varicose veins	Pentothal+ gas-oxygen	20 i.m.	140/100	95/ 85	190/130	140/100	+30	2	30	At least 1¾ hr. 140/100 mm.
22 M,18	Torek	Spinal nupercaine	20 i.m.	120/ 70	70/ 60	120/ 70	120/ 70	+16	5	33	At least 50 min. 120/70 mm.
23 M,69	Steinach II	Local procaine	20 i.m.	220/150	55/ 50	145/ 75	130/ 75	+ 8	4	30	At least 45 min. 130/75 mm.
24 F,34	Cholecystectomy	Spinal nupercaine +pentothal	25 i.m.	110/ 60	70/ 50	130/ 70	130/ 80	+30	4	17	At least 2¼ hr. 130/80 mm.

TABLE I.—SUMMARY OF CASES SHOWING EFFECT OF METHEDRINE ON BLOOD PRESSURE AND PULSE RATE—Continued

No., Sex, Age	Operation	Anesthetic	Dose in mgm.	Blood pressure in mm.				Effect on pulse rate per min.	Time taken for methedrine to act—min.	Time to produce maximum rise in blood pressure—min.	Duration of action and blood pressure after this time
				Preoperative blood pressure	Blood pressure just before giving methedrine	Maximum blood pressure after methedrine	Final blood pressure				
25 F,47	Cholecystectomy	Spinal nupercaine + local procaine	30 i.m. + 15 i.m.	135/ 95	0	125/ 80	120/ 80	+16	2	22	At least 4 hr. 120/80 mm.
26 F,55	Cholecystectomy	Spinal nupercaine	20 i.m.	140/ 70	65/ 35	120/ 60	120/ 75	+10	5	35	At least 1¼ hr. 120/75 mm.
27 F,51	Cholecystectomy	Spinal nupercaine + pentothal	25+15+25 i.m.	140/100	50/ 40	105/ 85	100/ 70	+16	2	30	3 hr. 100/70 mm.
28 F,47	Cholecystectomy	Spinal nupercaine	20 i.m.	170/110	110/ 85	170/100	170/100	+10	4	15	At least 1 hr. 20 min. 170/100 mm.
29 M,72	Amputation	Local procaine + pentothal	15 i.m.	120/ 70	80/ 60	120/ 70	110/ 70	+26	4	15	At least 1¼ hr. 110/70 mm.
30 F,33	Cervical sympathectomy	Gas-oxygen-ether	30 i.m.	120/ 70	70/ 55	130/ 80	120/ 65	+12	2	5	At least 2¼ hr. 120/65 mm.
31 F,33	Cervical sympathectomy	Gas-oxygen-ether	25 i.m.	120/ 70	50/ 40	120/ 80	115/ 75	+20	2	7	At least 5¾ hr. 115/75 mm.
32 M,60	Excision rectum	Spinal nupercaine	10 i.m.	120/ 80	90/ 75	120/ 60	115/ 75	+10	3	15	At least 20 min. 115/65 mm.
33 M,70	Hemorrhoids	Spinal nupercaine	20 i.m.	160/ 95	50/ 40	150/ 80	140/ 80	−14	20	45	At least 4 hr. 140/80 mm.
34 F,29	Pilonidal sinus	Spinal nupercaine	30 i.m.	120/ 80	90/ 75	100/ 60	100/ 60	+20	5	25	At least 1¼ hr. 100/60 mm.
35 F,35	Thyroidectomy	Local procaine	10 i.m.	120/ 80	90/ 60	110/ 60	110/ 60	0	5	10	Until end of operation. 110/60 mm.
36 F,45	Hysterectomy	Spinal nupercaine	30 i.m.	150/ 90	90/ 60	240/150	150/ 90	+20	3	14	At least 1 hr. 20 min. 150/90 mm.
37 F,32	Laparotomy	Spinal nupercaine	30 i.m.	120/ 70	0	150/ 90	120/ 70	+16	3	14	At least 1 hr. 40 min. 120/70 mm.
38 F,31	Laparotomy	Spinal nupercaine + pentothal	25 i.m.	130/ 85	50/ 40	110/ 70	110/ 70	−18	5	25	At least 50 min. 110/70 mm.
39 M,50	Ureter	Spinal nupercaine	25 i.m.	110/ 70	70/ 65	110/ 75	110/ 75	+ 2	5	20	At least 1½ hr. 110/75 mm.
40 M,55	Bladder	Local + pentothal	30 i.m.	140/ 70	100/ 80	120/ 70	120/ 70	+ 4	3	10	At least 1 hr. 40 min. 120/70 mm.
41 F,58	Mastectomy	Pentothal + open ether	3x15 i.m.	120/ 85	0	120/ 85	115/ 80	− 4	3 to 5	23	At least 5½ hr. 115/80 mm.
42 F,33	Kidney	Spinal nupercaine	30+20 i.m.	125/ 80	35/ 30	125/ 90	125/ 90	Not measured	5	35	At least 2 hr. 125/90 mm.
43 F,33	Kidney	Spinal nupercaine + pentothal	30+30+15 i.m.	115/ 80	65/ 60	90/ 65	90/ 70	+48	4 to 5	7	B.P. not raised above 90/70 mm. after 3 hr.
44 F,18	Kidney	Spinal nupercaine	30 i.m.	130/ 80	55/ 45	140/ 90	130/ 80	+26	4	25	At least 6 hr. 130/80 mm.
45 F,34	Kidney	Spinal nupercaine	30 i.m.	130/ 80	65/ 45	135/ 75	120/ 80	−10	2	12	At least 3 hr. 120/80 mm.
46 M,35	Varicose veins	Gas-oxygen-ether	20 i.m.	140/100	95/ 85	160/100	140/100	+18	3	15	At least 1½ hr. 140/100 mm.
47 F,60	Varicose veins	Spinal nupercaine + pentothal	15 i.m. + 15 i.v.	130/ 80	55/ 40	145/ 90	125/ 70	+36	1	12	At least 4 hr. 125/70 mm.
48 M,40	Hernia	Spinal + pentothal	25 i.m.	125/ 80	70/ 65	150/ 80	125/ 80	+24	3	15	At least 2½ hr. 125/80 mm.

TABLE I.—SUMMARY OF CASES SHOWING EFFECT OF METHEDRINE ON BLOOD PRESSURE AND PULSE RATE—Continued

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				Preoperative blood pressure	Blood pressure just before giving methedrine	Maximum blood pressure after methedrine	Final blood pressure				
49 M,61	Excision rectum	Spinal nupercaine	30+20 i.m.+20 i.v.	110/ 70	70/ 65	115/ 75	115/ 75	+22	8	60 ?	48 hr. 115/75 mm.
50 F,36	Gastrectomy	Pentothal +N_2O and O_2	20 i.m.	150/ 90	95/ 80	150/ 80	140/ 85	+16	5	25	At least 6 hr. 140/85 mm.
51 M,25	Gastrojejunostomy	Spinal+ open ether	25 i.m.	110/ 65	80/ 60	130/ 75	110/ 70	− 6	2	30	At least 4½ hr. 110/70 mm.
52 F,60	Laparotomy	Spinal nupercaine	25 i.m.	120/ 80	80/ 65	135/ 80	120/ 80	+ 4	3	20	At least 3½ hr. 120/80 mm.
53 M,34	Gastrojejunostomy	Local +pentothal	10 i.v.+20 i.m.	110/ 80	70/ 55	125/ 85	100/ 70	+20	1½	15	At least 2½ hr. 100/70 mm.
54 F,67	Hernia	Local decicaine	20 i.v.	120/ 75	0	120/ 80	118/ 80	+12	1	5	At least 6¼ hr.

was dissected out and injected with amethocaine; blood pressure fell to 60/40 millimeters, and at the end of the operation 25 minutes later to 50/40 millimeters. Methedrine, 15 milligrams intravenously and 15 milligrams intramuscularly was given. In 2 minutes pressure rose to 70/50 millimeters; in 4 minutes to 80/60 millimeters and in 7 minutes to 120/80 millimeters. Thirty minutes later it was 115/75 millimeters and remained so for 3½ hours. The pulse rate rose from 70 to 94. Patient recovered.

CASE 41. F. T., female, aged 58 years. Operation consisted of radical mastectomy for carcinoma of breast; duration, 1 hour 20 minutes. The preoperative blood pressure was 120/85 millimeters. The anesthetic was pentothal followed by open ether. The pressure fell to 90/70 millimeters within 10 minutes of the incision and 10 minutes later was too low to record. To avoid a sudden high rise of blood pressure, which might produce severe hemorrhage small doses of methedrine were given. Two minutes after 15 milligrams was given pressure was 40/30 millimeters; 20 minutes later it was 100/80 millimeters. Two further injections of 15 milligrams at intervals of 1 hour and 1½ hours, respectively, restored the blood pressure to 120/80 millimeters. Duration of action at least 5½ hours. Pulse rate fell from 88 to 84 after first injection, and rose from 78 to 80 and 76 to 84 after the second and third injections. Patient recovered.

CASE 44. C. H., female, aged 18 years. Operation consisted of a left renal sympathectomy and plastic on kidney pelvis for painful hydronephrosis, and lasted 1 hour. The anesthesia was spinal with nupercaine. The preoperative blood pressure was 130/90 millimeters. Ten minutes after spinal anesthesia, pressure was 80/60 millimeters, 20 minutes later 55/45 millimeters, when the kidney was explored. Methedrine, 30 milligrams, given intramuscularly. Pressure started to rise in 4 minutes. In 12 minutes it was 120/90 millimeters, rose to 135/100 millimeters in 25 minutes, and was not below 130/90 millimeters throughout operation. Pressure was 135/90 millimeters when patient was returned to bed, and 130/88 millimeters 5 hours 20 minutes after giving methedrine. Increase in pulse rate was from 90 to 115 per minute, but dropped to 90 per minute within 15 minutes. Patient recovered.

CASE 47. E. T., female, aged 60 years. An operation consisting of ligature and injection of varicose veins and removal of lipoma of thigh lasted 35 minutes. The anesthesia was produced by pentothal followed by nitrous oxide-gas-oxygen-trichlorethylene. The preoperative blood pressure was 130/80 millimeters. Five minutes after the injection the blood pressure fell to 60/50 millimeters and after injection of the veins to 55/40 millimeters. After waiting in vain 20 minutes for natural recovery, methedrine, 15 milligrams, was given intravenously and 15 milligrams was given intramuscularly. In 2 minutes blood pressure was 80/60 millimeters, and rose within another 3 minutes to 135/90 millimeters. For 8 minutes it was between 135/90 and 145/90 millimeters. It quickly settled to 130/80 millimeters and 3½ hours later was 125/70 millimeters. There was a temporary increase in pulse rate from 60 to 96 per minute, which dropped to 80 in 15 minutes. Patient recovered.

CASE 49. C. R., male, aged 61 years, was subjected to an abdominoperineal excision of the rectum for carcinoma. Operation lasted 1½ hours. The anesthetic was nupercaine, spinal, combined with amethocaine into inferior mesenteric and presacral plexus. The preoperative blood pressure was 110/70 millimeters. When incision was made, the pressure was 70/65 millimeters. Methedrine, 30 milligrams, was administered intramuscularly 15 minutes later and blood pressure was raised to 80/70 millimeters in 7 minutes. Thirty minutes later methedrine, 20 milligrams, was given intravenously and same dose intramuscularly. There was no response. Fifty minutes later at the end of the operation the blood pressure suddenly rose to 115/75 millimeters and was maintained at this level at least for 48 hours, when observations stopped. We think the blood pressure rose at the finish when the tight shoulder harness was released; it probably restricted the venous circulation. Patient recovered.

CASE 51. H. H., male, aged 25 years. Partial gastrectomy and gastrojejunostomy were done for duodenal ulcer. The anesthetic was pentothal, followed by nitrous oxide gas-oxygen. Operation lasted 2 hours. The preoperative blood pressure was 110/65 millimeters. After exploration of the stomach and the freeing of the pylorus the blood pressure dropped to 80/60 millimeters. After 20 minutes methedrine, 25 milligrams, was given intramuscularly. Within 7 minutes the blood pressure rose to 115/70 millimeters and 12 minutes later was 120/75 millimeters.

Eventually it rose to 130/75 millimeters, then in 10 minutes fell to 120/75 millimeters and was maintained between 110/70 and 120/70 millimeters for the rest of the operation. Three hours later the pressure was 110/70 millimeters. Pulse rate fell after methedrine from 60 to 54 per minute. Patient recovered.

SUMMARY

Of 130 observed operations, 54 patients were found suffering from an unduly low systolic or pulse pressure and some degree of impending surgical shock. The capacity of methedrine to meet the needs of these patients has been studied under average operating conditions of four general hospitals. The drug was never given for the sake of measuring its effect on a patient; but only when the surgeon, anesthetist and observer agreed that the patient was in need of it. Anesthetics included all those in common use.

Under these conditions methedrine has been proved to be an effective pressor agent with a gradual prolonged action, and with no undesirable side effects in the dosage stated.

The effective dose is from 15 to 30 milligrams intramuscularly or 10 to 20 milligrams intravenously plus a depôt dose of 10 to 20 milligrams intramuscularly.

In 97 per cent of the cases the systolic pressure was restored to normal levels in from 2 to 18 minutes. The systolic pressure was raised from an average of 67 millimeters to an average maximum of 135 millimeters and settled to an average minimum of 124 millimeters. This last figure corresponds to 91 per cent of the average preoperative value (137 mm.). There is no abnormally high rise if the patient's circumstances are evaluated and the dose is selected accordingly. One injection was adequate in 81 per cent of patients; repeated injections were given in 17 per cent; in 1 case, or 2 per cent, there was no response.

The pressor effect is maintained for several hours after operation.

Clinically methedrine is considered to be superior to adrenalin, ephedrine, and pholedrine as a pressor agent.

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RELIEF OF ESSENTIAL DYSMENORRHEA WITH ETHINYL ESTRADIOL

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ESSENTIAL dysmenorrhea was observed by Wilson and Kurzrok to occur only in ovulatory cycles. Confirmation was offered by Sturgis and Albright (6) who in the same report described the mechanism of estrogenic relief of dysmenorrhea under prescribed conditions. Sturgis (5) later utilized the orally active nonhormonal estrogen, stilbestrol, in treating single dysmenorrheic menstrual episodes. Subsequently, estradiol diproprionate was employed in the treatment of essential dysmenorrhea by Sturgis and Meigs (7) in a further development of the basic thesis. Sturgis (5) defines essential dysmenorrhea as menstrual cramps associated with the presence of a secretory endometrium.

It is the purpose of this presentation to examine the effect on essential dysmenorrhea which may be obtained by means of an orally effective estrogen, ethinyl estradiol. This preparation was synthesized by Hohlweg and Innhoffen and is exceptionally potent, very small quantities being effective. It appears to be removed at a slow rate by the liver (1). Experience of different observers (1, 8) agrees in that it does not show significant toxic manifestations. Those who cannot tolerate the substance appear to be very infrequently found.

Sturgis' development of the use of estrogens in controlling the symptoms of dysmenorrhea had as a basis the inhibition of ovulation. When an adequate dose of estrogen was given early enough in the cycle to prevent the follicle-stimulating hormone production in the hypophysis and was continued sufficiently long, it was effective in relieving the expected menstrual period from pain. This appears to be an all-or-none effect. To obtain this, maturation and rupture of the follicle must be prevented by estrogen treatment for about 21 days prior to the next expected menses.

Essential dysmenorrhea involves the ovulation mechanism since it occurs only in association with a functioning corpus luteum (3). Observations of basal temperatures showed a progestational biphasic rise in the second half of the cycle in patients who had dysmenorrhea. When ovulation is suppressed no dysmenorrhea followed (5, 6, 7). Estrogen in an effective dose, when given by the 5th cycle day and maintained for at least 3 weeks, prevented the recurrent crampy-like pains characteristic of dysmenorrhea of the essential type (7).

Experimental. Twelve patients were followed from 6 to 15 months, ovulation being determined by means of basal body temperatures, occasionally supplemented with vaginal smears and endometrial biopsies. The ages ranged from 19 to 35 years. None of the patients presented any additional gynecological disorder either by history or on physical examination. This study comprises 138 dysmenorrheic cycles evaluated by the basal body temperature method. Forty-four of these cycles have been influenced by ethinyl estradiol. This alteration has been obtained by giving 0.05 milligram of the preparation once daily by oral administration beginning at least 21 days prior to the subsequent menstrual period. This was continued for 24 days. A total dose of 1.2 milligrams sufficed for the entire cycle. In some cases, at the onset of the ensuing menstruation, the 24 day course was repeated. The third cycle was untreated and was usually accompanied by dysmenorrhea. Due to the hypothetical possibility of developing hyperplasia of the endometrium, the plan of therapy has included 1 month in 3 free from estrogen. This appears to preclude the contingency of persistent estrinism.

Following the estrogen inhibited cycles, subsequent cycle lengths ordinarily showed some change. When an estrogen was given, the cycle tended to be prolonged. The aftercoming untreated cycle is compensatorily shorter than the mean cycle length. During an estrogen influenced cycle the duration of flow ordinarily persisted about 2 days longer than the mean.

Observations. No spontaneous anovulatory cycles were observed among the dysmenorrheic group in this report. It appears that spontaneous anovulation in a patient with dysmenorrhea is a very rare occurrence. Chance anovulatory cycles in those treated with ethinyl estradiol is too small to be significant (Table I).

The catamenia appeared 6 days on the average, after the last dose of ethinyl estradiol. In 6 of the

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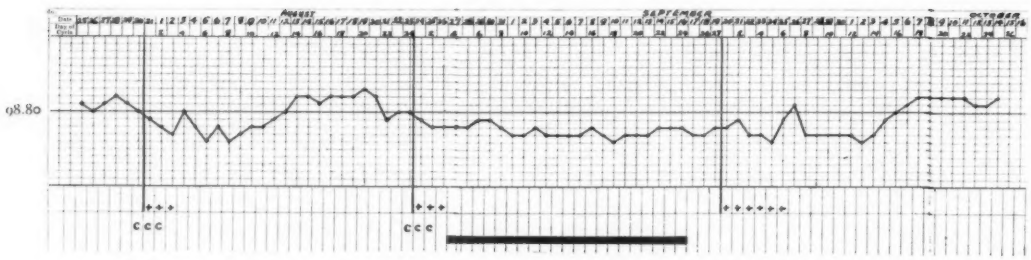

Fig. 1. The temperature curve of an estrogen treated (ovulation inhibited) cycle between two untreated cycles. The latter were accompanied by dysmenorrhea. The suppressed cycle was free from cramp-like pain and revealed no progestational temperature increase. +Indicates menstruation; c, indicates dysmenorrhea.

44 instances there was no bleeding and 1 of 2 courses was followed. Either the patient was given an additional 24 ethinyl estradiol tablets after a free interval of 1 week, or nothing was given and the patient was allowed to have a normal menstrual period without treatment. In the latter event dysmenorrhea invariably occurred. Each of the patients has been treated repeatedly. In no instance did dysmenorrheic pain occur. Consecutive cycle inhibition of ovulation with ethinyl estradiol has been followed over a period of 2 cycles whereupon the patient was allowed to ovulate. The ensuing menstruation was accompanied by dysmenorrhea (Table II).

Estrogen altered the normal cycle by inhibiting ovulation, when given sufficiently early and continued for at least 21 days. This prevents ovulation and the attendant progestational phase of the cycle. As a result the duration of bleeding tended to be somewhat longer, in this series 1.8 days greater in duration. The flow is described as less profuse but more prolonged. Furthermore, the length of the cycle was prolonged from a mean of 28 days to 29.7 days. As a consequence the succeeding cycles particularly when untreated were usually shortened to 25 or 26 days. Menstruation in these shortened aftercoming cycles tended to be more nearly normal in duration and quantity. Furthermore, it was accompanied by cramps.

ANALYSIS OF STUDY

Ethinyl estradiol as a modified hormone was effective when administered orally. There were no instances of nausea in this series and it was tolerated and liked by the patients. There were essentially no toxic sequelae in these patients or in the reports of others (1, 8). Moreover, the effective dose of the estrogen was exceedingly small for these patients, being only 0.05 milligrams daily.

Although the therapy is simple and the results direct, miscalculation in the timing of dosages or omission of part of the course might occur. Such conditions predispose to failure by permitting the impending ovulation to occur. Basal temperature curves, when properly taken, reflect the inhibition of ovulation by a persistently low temperature level (3, 4). Although the day to day temperature curve variation is often marked, the trend of the anovulatory cycle curves are uniphasic. Furthermore, the relief is not permanent but requires repetition monthly. Sturgis, who has had approximately 5 years' experience with intermittent estrogen treatment of essential dysmenorrhea, concludes, "this type of therapy has little to offer as a permanent cure (7)". As a temporary expedient, it is satisfactory in the management of patients with severe essential dysmenorrhea who can be assured of relief in some of her cycles. In order to inhibit ovulation, an estrogen must be present in effective concentration continuously from very early in the cycle. This plan amounts to starting estrogenation at least 3 weeks prior to the ensuing menses. This means the onset of estrogen administration in the average cycle occurred about the 4th or 5th day.

TABLE I.—SUMMARY OF CYCLE DATA

	Number	Estrogen treated	Estrogen treated amenorrheic
Cycles studied	138	44	6
Patients	12	12	2

TABLE II.—EFFECT OF ESTROGEN ON THE CYCLE

	Mean in days	Number of cycles
Control cycle length	28	94
Estrogen treated cycle length	30	44
Duration of bleeding in estrogen treated cycles	5	44
Length of subsequent cycles	25	38
Interval from estrogen withdrawal to bleeding	6	44

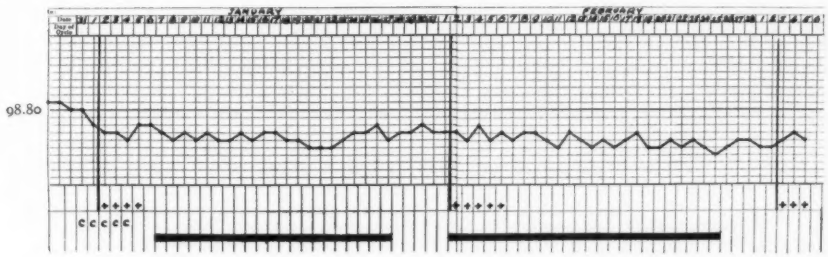

Fig. 2. Temperature recordings of 3 successive estrogen treated pain free cycles with a uniphasic response characteristic of anovulation. These followed a biphasic temperature curve which was accompanied by dysmenorrhea.

Fig. 3. Successive basal temperature curves, the first showing suppression of ovulation type and the second escape from the suppression. The second course of estrogen started 8 days after the last previous dose which was too long a withholding interval.

There was no menstruation in 13 per cent of the estrogen treated cycles. This suggests that both ovulation and the catamenia were absent during these particular estrogen-treated cycles. Ordinarily the estrogen is stopped after 21 to 24 days of continuous daily administration. There followed a withholding interval of from 4 to 7 days in order to allow withdrawal bleeding to occur. The bleeding resembled menstruation except as has been described. Should the withholding time be prolonged, it is likely that ovulation will no longer be suppressed. Thereupon a pituitary gonadotropin tide apparently precedes ovulation with its consequent progestation, the dissolution of which is attended by dysmenorrheic effects. From this it appears that for ovulation suppression in two or more consecutive cycles, it is requisite that the interval allowed for withdrawal bleeding be short, namely, 4 to 7 days.

Among failures of relief of dysmenorrhea by suppression of ovulation are a start late in the cycle or insufficiency of estrogen dosage. Furthermore, it is probable that there are further stimuli to cramp-like pain. For example, it is known that instrumentation of the cervix at any time of the cycle in patients susceptible to dysmenorrhea will result in the typical cramps ordinarily found only at the time of menstruation. These occasionally persist for many days after instrumentation or following the cessation of menstruation. Such untimely uterine pain is not ordinarily classed as essential dysmenorrhea. It is conceivable that clots, or excessive exercise might stimulate some of the symptoms resembling dysmenorrhea in an anovulatory cycle in women particularly susceptible to uterine stimuli.

Prolonged pituitary inhibition of ovulation is found naturally in instances of lactation, pregnancy, arrhenoblastoma, and granulosa cell tumor. On termination of any of these conditions, if the patient is in the reproductive age group, normal ovulatory cycles are regularly resumed. This has also been so following the administration of subcutaneous estrogen (6). Anovulatory bleeding, one of the recognized types of menstruation, then can occur with reasonable regularity, but precise 28 day cycles are not to be anticipated.

None of the patients followed by Sturgis (7) for nearly 5 years nor those in our hands failed to ovulate when the estrin was withheld. Not only has ovulation invariably recurred under such circumstances, but dysmenorrhea regularly accompanied the subsequent menstruation. A similar suppression of ovulation is found, of course,

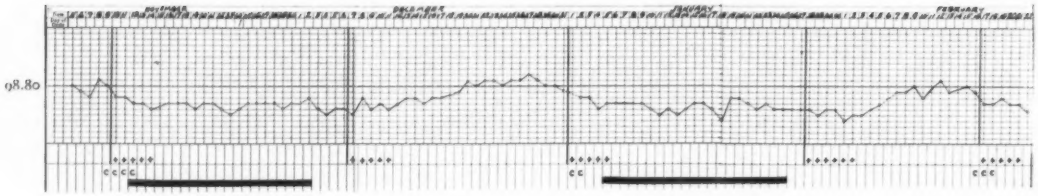

Fig. 4. Four successive cycles, the first and third being estrogen treated, thus exhibiting anovulation. The second and fourth cycles are short biphasic affairs revealing the progestational temperature elevation. The latter were attended by crampy dysmenorrhea, the former none at all.

during lactation. In some respects the inhibition of lactation during pregnancy may be considered to resemble that induced by this treatment. It seems permissible in the event of intractable dysmenorrhea of disabling extent to justify the temporary suppression of ovulation. As previously observed (7), for differential diagnosis between essential dysmenorrhea and recurrent abdominal pain from other causes, assistance is offered by a therapeutic trial with an estrogen as an ovulation suppression agent.

Until there has been considerably more experience, estrogenic suppression of ovulation as a means of routine relief of dysmenorrhea would not appear indicated. The merit of this technique appears to be in its contribution to understanding the dysmenorrhea mechanism, and in its aid in management of instances of intractable dysmenorrhea temporarily. Prolonged ovarian rest or follicle-stimulating hormone suppression has not been shown to be desirable.

The psychogenic component and the frequency of immature development of the personality in instances of dysmenorrhea are well recognized by workers in this field. Most of these patients seem to need confidence, and in this respect the method offers a step toward a sound relationship between the patient and her physician in the establishment of a satisfactory adjustment.

SUMMARY

One hundred and thirty-eight dysmenorrheic cycles have been followed by the basal body temperature method. Of these, 44 cycles have been treated for 21 to 24 days by the oral administration of 0.05 milligrams of ethinyl estradiol, starting early in the cycle. This has been associated with inhibition of ovulation as determined by the basal body temperature and by freedom from dysmenorrheic cramps. Successive cycles have been treated in this manner with a resultant relief from dysmenorrhea. The plan, as it is being currently employed, involves permitting a cycle without treatment following each two successive cycles in which the dysmenorrhea has been relieved.

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PERFORATION OF THE GALL BLADDER

A Study of Twenty-Five Consecutive Cases

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THE subject of perforation of the gall bladder is of great practical importance. On its frequency and dangers depends much of the decision as to when to operate in acute cholecystitis. If the incidence and mortality of this complication are high, the argument for early operation in acute cholecystitis is strengthened; while if perforations of the gall bladder are rare and seldom fatal, delay in the surgical treatment of acute cholecystitis would not be so dangerous. In an attempt to throw light upon this subject, the present series of 25 cases of perforated gall bladder seen at the Henry Ford Hospital between 1921 and 1943 is reviewed and correlated with other reports in the literature.

FREQUENCY

Our series of 25 perforated gall bladders represents all those available in the records of the Henry Ford Hospital. Twenty-four of these were found at operation and one was found at necropsy. During this period there were 366,459 admissions to the hospital and clinic. The exact number of these patients admitted to the hospital is not available. During the years 1921 to April, 1943, when there were 2,750 gall-bladder operations, there were 25 instances of perforated gall bladder, an incidence of 0.9 per cent. A much truer idea of the incidence is shown by the fact that during the years 1925 to 1943 when there were approximately 490 operations for acute cholecystitis, there were 23 instances of perforated gall bladder, an incidence of 4.7 per cent. In reviewing the recent literature we were struck by the wide range of figures given as to the incidence of perforation of the gall bladder, these varying from 1 to over 20 per cent. This is easily explained, however, because the lower figure is usually given for the incidence of *all* biliary disease, whereas in the higher figures the authors are talking only of the incidence in *acute* cholecystitis. It seems logical that when one ceases thinking of perforated gall bladder as a rare disease—only 1 per cent of biliary tract affections—and concentrates on the view that perforations occur in about 13 per cent of the cases of acute cholecystitis, this complication will be discovered earlier and the mortality rate lowered by earlier operation. The incidence of the condition as shown in several articles in the literature is shown in Table I. It is seen that in 12,915 operations on the gall bladder, perforation of that organ was found, on an average, in 2.8 per cent of the cases. Our own statistic of 0.9 per cent represents the lowest figure whereas Mentzer (1936), of San Francisco, reported the highest percentage incidence of 12.1. In a collected series of 2,261 cases of acute cholecystitis, perforated gall bladder occurred, on an average, in 13 per cent of the cases. Again, our own figure of 4.7 per cent, not shown in the table, is low, while Mentzer's figure of 23.5 per cent is the highest. In a total of 433 perforated gall bladders the average mortality was 20.8 per cent.

Perforation of the gall bladder is usually a consequence of acute cholecystitis with gangrene but occasionally results from other special conditions such as typhoid. Tongs (1931) reported a case of perforation of the gall bladder in typhoid. Stone (1937) reported a case of perforated gall bladder occurring in the late stage of pregnancy in which operation resulted in recovery. One of the early classical articles on the subject of perforation of the gall bladder is by McWilliams (1912). This author collected 108 cases of this syndrome with perforation into the free peritoneal cavity. His interest in the subject was aroused by having two such cases of his own and he reviewed the Presbyterian Hospital (N.Y.) series of 365 gall-bladder operations done in the preceding 15 years with 6 free perforations (1.6 per cent). In only 2 of the 6 cases was the result fatal. Blalock (1924) found 21 perforations of the gall bladder in a series of 735 gall-bladder operations performed at the Johns Hopkins Hospital, an incidence of 2.9 per cent. Heuer (1934) collected data concerning 502 perforations of the gall bladder reported in the literature. Fifield (1926) reported a series of 28 cases of

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Dr. Cowley is now on active duty with the Army of the United States in Africa and was unable to participate in the final stage of writing this paper. He should not be held responsible for any errors nor for all of the ideas expressed therein.

TABLE I.—INCIDENCE OF PERFORATED GALL BLADDERS IN THE LITERATURE

Author	Total gall-bladder cases reviewed	Number of cases with acute cholecystitis	Number of perforated cases	% of total cases perforated	% of acute cases perforated	Mortality of perforated cases
Blalock, 1924	735	—	21	2.9	—	—
Fifield, 1928	1066	—	28	2.6	—	43.0
Mitchell, 1928	1270	—	16	1.2	—	—
Heuer, 1934	800	106	23	2.8	21.0	34.7
Eliason and McLaughlin, 1934	490	—	9	1.8	—	11.0
Heyd, 1935	489	—	6	1.2	—	16.6
D'Abreu, 1935	116	—	3	2.6	—	66.6
Mentzer, 1936	149	51	18	12.1	23.5*	27.7
Sanders, 1937	886	—	46	5.2	—	17.4
Hotz, 1939	—	574	69	—	12.1	26.1
Stone and Douglass, 1939	775	170	17	2.0	10.0	5.8
Glenn, 1939†	—	219	18	—	7.7	11.1
Atlee and Atlee, 1940	—	193	16	—	7.7	18.8
McCloskey and Lehman, 1940	—	68	12	—	17.6	16.6
Edwards, Gerwig, and Guyton, 1941	1124	194	21	1.8	10.8	28.5‡
Wallace and Allen, 1941	2273	415	64	2.8	15.4	17.2
Glenn and Moore, 1942	—	350	25	—	7.1	12.0
McLanahan, Trout, and Weary, 1942	—	140	14	—	10.0	42.8
Cowley and Harkins, 1943	2742	—	25	0.9	—	24.0
Total or average	12,915	2261	433	2.8	13.0	20.8

*Five of the 18 total perforations occurred in cases of acute and subacute exacerbation of chronic cholecystitis. These are not included in the estimation of the percentage incidence in the acute cholecystitis cases which is already the highest of any in this column.
†These cases are not included in the totals or averages as they are duplicated by those of Glenn and Moore (1943) below.
‡This mortality percentage includes 3 cases moribund on admission and not operated upon. The mortality of the cases operated upon was 16.6 per cent.

perforation of the gall bladder seen at the London Hospital during the 25 year period 1901 to 1925, found in 1,066 gall-bladder operations as shown in Table I. The incidence of perforation of the gall bladder in 130 necropsies on biliary tract cases was found by Colp and Ginzburg to be 6.2 per cent (8 cases, 7 with free perforation and 1 a rupture of a pericholecystic abscess). In a review published after this article was prepared, Hicken and Coray (*Rocky Mountain M. J.*, 1943, 40: 524–529) reported that the incidence of gall-bladder perforation in their series of cases of acute cholecystitis was 25.6 per cent.

ANALYSIS OF CASES

The patients in our series of 25 instances of perforated gall bladder were operated upon at the Henry Ford Hospital during the period September, 1921, to April, 1943, inclusive.

Sex. Most of our patients—16 or 64 per cent—were females, while 9 or 36 per cent were males. Sanders (1937) reported 46 gall-bladder perforations in 22 females, and 24 males, a sex ratio slightly the reverse of ours. On the other hand 18 of Schaeffer's (1942) 20 cases were females; 10 of Stone and Douglass' 17 cases (1939) were females; and Judd and Phillips (1933) reported that 43 of their 61 patients with perforation of the gall bladder were women. The greater incidence in females probably merely reflects the fact that all types of gall-bladder disease are more common in the female sex.

Age. Table II shows that 60 per cent of our cases occurred past the age of 50 years. The average age of the 20 patients reported by Schaeffer in 1942 was 59 years. Judd and Phillips (1933) reported that the oldest of their 61 patients with perforated gall bladder was aged 68 years, the youngest aged 24, but by far the majority of patients were more than 50 years of age. In Stone and Douglass' series (1939) the average age of the patients was 52 years.

Duration of present illness. As shown in Table III, the present attack was of less than 7 days' duration in more than half the cases, but in several instances a much larger history was present.

Duration of history of previous attacks. While many of the patients came in with an acute at-

TABLE II.—AGE

Age in years	No. of cases	Percentage
20–29	2	8
30–39	2	8
40–49	6	24
50–59	4	16
60–69	8	32
70–79	3	12

tack, most of them (over 90 per cent) complained of previous incidents of gall-bladder disease (Table IV). In many of these cases a history of many years duration was obtained. Practically all of Stone and Douglass' (1939) cases gave a history of pre-existing chronic cholecystitis. Eliason and McLaughlin (1934) stated that in all but 1 of their 9 cases a definite history of previous attacks of cholecystitis could be elicited, the duration of symptoms ranging from 18 months to 15 years, and averaging 6 years. Only 3 of the 20 patients with perforation of the gall bladder reported by Schaeffer (1942) complained of symptoms for less than a year. In this series of 20 cases the duration of symptoms varied from 2 weeks to 35 years, but the majority of cases were of long duration.

Symptoms. Nausea, usually with vomiting, and persistent pain in the right upper quadrant of the abdomen were the commonest symptoms. Radiation to the back occurred in 40 per cent of cases. Stone and Douglass (1939) also reported that all of their cases had pain as their main complaint. Unfortunately, the presence of pain is of little aid in differentiation from acute cholecystitis without perforation.

Signs. While in most of our cases the white count was elevated (in 32 per cent of the cases it was over 20,000) in 24 per cent it was below 10,000. Wallace and Allen (1941) also found the temperature and white count to be of little value as a guide to the probability of impending perforation. However, Edwards, Gerwig, and Guyton (1941) found the leucocyte count to average around 18,000 to 20,000 in their series of 21 cases. Stone and Douglass (1939) found the average white count to be 14,000. In the series of 20 cases reported by Schaeffer in 1942, in all but one the white count was elevated. As seen in Table VI, elevations of the polymorphonuclear percentage, temperature, pulse, and respirations were of some

TABLE III.—DURATION OF PRESENT ILLNESS

Duration of illness	No. of cases	Percentage
1 to 3 days	9	36
4 to 7 days	5	20
1 to 4 weeks	4	16
1 to 3 months	3	12
Over 3 months	2	8
Not known	2	8

TABLE IV.—DURATION OF HISTORY OF PREVIOUS ATTACKS

Duration of history of previous attacks	No. of cases	Percentage
None	2	8
0 to 3 months	1	4
3 to 6 months	3	12
6 to 12 months	2	8
1 to 2 years	0	0
2 to 5 years	6	24
5 to 10 years	2	8
10 to 15 years	3	12
Over 15 years	1	4
Yes	3	12
For years	2	8

help, but were not invariable signs. Right upper quadrant tenderness was present in 96 per cent of the cases, a right upper quadrant mass in 24 per cent, generalized abdominal tenderness in 28 per cent, and jaundice in 20 per cent of the cases. The highest icteric index obtained was a reading of 47 in Case 24. This patient had a history of intermittent jaundice for 17 years and at operation, besides a gall bladder perforated into the liver and into a chronic pericholecystic abscess, there was an impacted jack-stone type of gall stone in the ampulla of Vater (see Fig. 1). Schaeffer (1942) in his series of 20 cases found jaundice to be present exactly as often as we did (20 per cent). Stone and Douglass (1939) in their 17 cases found 6 instances of jaundice (35 per cent).

Roentgen findings. As seen in Table VII roentgen-ray examination generally showed non-filling of the gall bladder.

Preoperative diagnosis. In only 12 per cent of the cases was the correct diagnosis of perforated gall bladder even considered in the written diagnosis as is seen in Table VIII. Sanders (1937) reported that a correct preoperative diagnosis was made in only 4 of his 46 cases of perforated gall bladder (9 per cent). Furthermore, Eliason and McLaughlin (1934) stated that "a correct preoperative diagnosis of a perforated gall bladder is quite unusual."

Classification. The most useful classification is that of Niemeier (1934) who grouped the cases into 3 types as shown in Table IX.

Stout and Hibbard (1934) advised another classification, dividing perforations of the gall bladder into five types rather than the three of

TABLE V.—SYMPTOMS

Symptoms	Present	Percentage
Pain in right upper quadrant	25	100
Nausea	20	80
Vomiting	18	72
Radiation to back	10	40
Generalized abdominal pain	5	20

TABLE VI.—SIGNS

	No. of cases	Percentage
White count, below 6,000	1	4
6–10,000	5	20
10–15,000	4	16
15–20,000	6	24
Above 20,000	8	32
Polymorphonuclear per cent, below 75	9	36
75–85	4	16
85–96	10	40
Temperature, normal	3	12
98.6–100°	9	36
100–101.5°	3	12
101.5–103°	7	28
Above 103°	3	12
Pulse, below 90	3	12
90–100	10	40
100–120	10	40
above 120	1	4
Respirations, below 20	1	4
20–30	21	84
above 30	2	8
Right upper quadrant tenderness	24	96
Right upper quadrant mass	6	24
Generalized abdominal tenderness	7	28
Jaundice	5	20

Niemeier, as follows: (1) perforation with communication with another viscus; (2) perforation with formation of a pericholecystic abscess; (3) acute free perforation; (4) perforation into the liver; and (5) external perforation.

According to this classification our cases would be classified as: type 1, 2 cases; type 2, 16 cases; type 3, 6 cases; type 4, 1 case; and type 5, none.

In Glenn and Moore's series (1942) of 25 cases, type 4 or perforation into the liver was quite common. Sixteen of Sander's (1937) series of 46 perforations had entered the liver.

TABLE VII.—ROENTGEN FINDINGS AT CHOLECYSTOGRAPHIC EXAMINATION

	No. of cases	Percentage
Non-filling	8	32
Non-filling with stone shadow	3	12
Flat plate negative	1	4
Unsatisfactory	1	4
No films	12	48

TABLE VIII.—PREOPERATIVE DIAGNOSIS

	No. of cases	Percentage
Acute cholecystitis	9	36
Chronic cholecystitis	7	28
Empyema of gall bladder	2	8
Subphrenic abscess	1	4
Choledocholithiasis and suppurative cholangitis	1	4
Uncertain or other	2	8
Ruptured gall bladder	3*	12

*In 1 case the diagnosis was made 4 months before operation, in the 2d case a diagnosis of duodenal ulcer and biliary fistula was made, and in the 3d case a diagnosis of acute cholecystitis with possible rupture was made.

TABLE IX.—GROUPING ACCORDING TO NIEMEIER CLASSIFICATION

	No. of cases	Percentage	Deaths	Mortality percentage
Type 1. Acute free perforation (acute). Bile stained fluid, 4; pus only, 2	6	24	1	16.6
Type 2. Pericholecystic abscess (subacute)	16	64	4	2.5
Type 3. Biliary fistula (chronic) Into duodenum, 1; into stomach, 1; into liver, 1	3	12	1	33.3

Free perforations of the gall bladder with generalized peritonitis (type 1 of Niemeier) represented only 24 per cent of our cases as seen in Table IX. In Table X, it is shown that in the literature these are more common, occurring about 75 per cent as often as the localized types. This may not represent the true picture as over half (53 of 99) of these cases were reported by one author (Hotz, 1939). Judd and Phillips (1933) found that only 2 of their 61 cases of perforation of the gall bladder showed extravasation into the general peritoneal cavity. These authors believe that part of this low incidence of generalized peritonitis may be due to the great distances which many of their patients have to travel. Cave (1938) pointed out that free perforations form only a small fraction of the entire group of gall-bladder perforations, "the majority of perforations of this viscus occur so gradually that protective adhesions between the gall bladder, omentum, and colon are formed, and usually result in a localized abscess." Atlee and Atlee (1940) had

TABLE X.—MORTALITY OF FREE AND LOCALIZED PERFORATIONS OF THE GALL BLADDER

Author	Free perforations		Localized perforations	
	No. of cases	Percentage mortality	No. of cases	Percentage mortality
Niemeier, 1934	2	0.0	6	0.0
Sanders, 1937	4	50.0	42	14.3
Pennoyer, 1938	7	100.0	—	—
Stone and Douglass, 1939	6	0.0	11	9.0
Hotz, 1939	53	35.9	16	0.0
Atlee and Atlee, 1940	4	50.0	11	9.0
Glenn and Moore, 1942	3	66.6	22	4.5
Schaeffer, 1942	14	42.8	6	33.3
Cowley and Harkins, 1943	6	16.6	19	21.5
Total or average	99	39.4	133	11.3

their 16 cases divided according to Niemeier's classification into type 1 (free perforation), 3 cases; type 2, 11 cases; and type 3, 1 case. Sanders' (1937) ratio was type 1, 4 cases (50 per cent mortality), type 2, 36 cases (5.5 per cent mortality), and type 3, 6 cases (66.6 per cent mortality). As seen in Table X, we are the only authors to report a lower mortality in the free perforation series (except Stone and Douglass). We have no explanation for this disparity. Hanley (1936) reported that of his 16 cases of perforation, 5 were associated with generalized peritonitis, 3 with localized peritonitis, and 8 with localized abscess. All of D'Abreu's 3 cases of gall-bladder perforation occurring in 116 gall-bladder cases were of the type associated with generalized peritonitis.

Free perforation is of interest in that it is the only type of peritonitis which will produce "bile peritonitis." In our series of 6 free perforations, in only 4 instances, was the peritoneal fluid bile stained. In none of these was the patient jaundiced. In the other 2 instances only pus was found in the peritoneal cavity. In diagnosing bile peritonitis it is important not to confuse biliary leakage with bile stained ascitic fluid in a jaundiced patient. In only 1 of our 4 cases with bile peritonitis were red counts or hematocrit determinations made to see if there was hemoconcentration; in this one case erythrocytes were normal.

Harkins, Harmon, and Hudson (1936) studied bile peritonitis experimentally. They pointed out that the two factors hitherto most frequently considered in the literature as important in the production of death in bile peritonitis were the toxic action of absorbed bile and the effects of anaerobic bacteria. In their own experimental studies, data are presented to support the view that the changes commonly found accompanying so called secondary surgical shock are an important lethal factor in bile peritonitis. The mechanism of production of this shock includes an escape of considerable amounts of plasma-like fluid from the injured peritoneal surfaces into the peritoneal cavity with associated hemoconcentration, fall in blood pressure, and decrease in bleeding volume. The condition of surgical shock is not considered to be the entire explanation of death in experimental animals. However, the shock is of such a degree as to make the animal an easier victim of associated toxic and bacterial action.

Clinically this work has little application for four reasons: (1) free perforation of the gall bladder occurs in only a fraction of all gall-bladder perforations; (2) human bile is less concentrated and less irritating than dog bile; (3) in most instances in which the gall bladder is diseased it has lost its concentrating power; (4) in many cases when a gall bladder perforates it contains no bile at all. However, in a few cases a true irritative bile peritonitis does occur, and Edwards, Gerwig, and Guyton (1941) stated that perforation into the free peritoneal cavity "initiates a severe chemical peritonitis, which is highly toxic."

Fig. 1. Distribution of stones in patient with two perforations of gall bladder. M. W., female, aged 51 years, had complained of intermittent attacks of icterus and right upper quadrant pain for 17 years. Her weight was 227 pounds, she had marked diabetes mellitus, with icterus index of 47 on admission to the hospital in January, 1943. At operation the gall bladder was found to be packed with stones and about 3 centimeters from the tip of the fundus there was a perforation into the liver, the cavity in the liver containing stones similar to those in the gall bladder. This perforation is marked by the tip of the arrow in the figure, the gall bladder being opened on the peritoneal surface. A second perforation from the right side of the fundus as shown by the white probe entered a pericholecystic abscess containing pus but no stones. The common and hepatic ducts were crowded with stones, which are grouped at the left. A single impacted stone with prongs like a jack-stone was present in the ampulla of Vater and had to be removed by a transduodenal approach. Death occurred on 6th postoperative day. Patient's temperature had risen to 109 degrees F. despite attempts to protect the liver with glucose and protein.

In our series we saw no cases of bile peritonitis without demonstrable perforation of the gall bladder as described by Clairmont and Von Haberer (1911). Greene and Coe (1940) reported an interesting case of "acute free perforation of the

TABLE XI.—SURGEON PERFORMING OPERATION

Surgeon	No. of cases	Percentage
McClure	9	36
Fallis	5	20
Harkins	3	12
Marshall	2	8
Davidson	2	8
Noel	2	8
Altemeier	1	4
No operation, found at necropsy	1	4

gall bladder occurring twice in the same patient."

Niemeier's second type, or perforation with localized abscess formation, is in most series the one most commonly encountered and accompanied by a relatively low mortality. In our 16 cases there were 4 deaths, a mortality of 25 per cent.

The third type, or perforation into a viscus, occurred 3 times in our series, once into the duodenum, once into the stomach, and once into the liver. Perforation into an adjoining viscus occurred in 7 of the 61 cases of Judd and Phillips (1933) (6 into duodenum, 1 into colon). Hotz (1939) had 6 cases perforate into the colon.

Many of the gall stones which pass from the gall bladder to the intestinal tract by way of fistulas cause intestinal obstruction as is well known. Thus, Foss and Summers (1942) reported that gall stones accounted for 4 per cent of all their intestinal obstructions, while gall stone obstruction occurred in 0.3 per cent of all their cases of gall-bladder disease. They reported 10 cases of gall-stone intestinal obstruction and studied 140 additional reported cases. In the large majority of cases in which the fistula was found, it existed between the gall bladder and the duodenum.

Empyema and gangrene are potent factors in the causation of rupture of the gall bladder. Wallace and Allen (1941) stated: "Gangrene with perforation is unusual before the sixth day after the onset of symptoms," and "with conservative treatment, even under careful observation in the hospital, gangrene with perforation cannot be anticipated and frequently progressed to a dangerous stage."

Pratt (1933) reported 3 perforations in a series of 15 gangrenous gall bladders with 2 recoveries and 1 death. In their series of 140 patients with acute cholecystitis operated upon at the Union Memorial Hospital during the period from September, 1923, to November, 1940, McLanahan, Trout, and Weary (1943) reported that there were 14 instances of perforation of the gall bladder (10 per cent). Six of these patients died, a mortality rate of 42.8 per cent. Nine of the perforations occurred in the group of 40 cases with gangrene. Thus, gangrene occurred in 28.5 per cent of the total group of acute cholecystitis.

Presence of gall stones. Stones were present in 92 per cent of our cases, 23 cases, and absent in 2 cases or 8 per cent. Figure 1 shows stones not only in the gall bladder but in the ducts, liver, and outside of the gall bladder in Case 24. Judd and Phillips (1933) reported that gall stones were present in 56 of their 61 cases of gall-bladder perforation. Sanders (1937) found stones to be present in 42 of his 46 cases of perforated gall bladder (91 per cent). All of Schaeffer's (1942) 20 cases with 1 possible exception had gall stones.

Type of operation. As seen in Table XI, the operations were performed by 7 surgeons over a period of 22 years. Table XII shows that in the majority of instances a cholecystectomy was performed. In the literature the preponderance of cholecystectomies done for perforated gall bladder is outstanding.

Bacteriologic studies. The 3 most common organisms found in our cases as shown in Table XIII were Bacillus coli, Bacillus lactis aerogenes and a nonhemolytic streptococcus.

Pathologic studies. Table XIV shows adenocarcinoma present in 1 case, acute inflammation in 15 cases, and chronic cholecystitis in 6 cases.

TABLE XII.—TYPE OF OPERATION

Operation	No. of cases	Percentage
Cholecystectomy—1 with appendectomy, 1 with choledochostomy	17	68
Cholecystostomy	2	8
Gatch cautery of mucosa	1	4
Drainage of abdomen	2	8
Drainage of abscess	2	8
No operation, found at necropsy	1	4

TABLE XIII.—BACTERIOLOGIC STUDIES

Bacteriology	No. of cases	Percentage
Positive culture	10	40
Bacillus coli,* 6; Bacillus lactis aerogenes,* 3; Bacillus anindolium, 1; nonhemolytic streptococcus,* 2; Gram + cocci,* 1		
Negative culture	2	8
Culture not recorded	13	52

*In some cases these organisms were present in combination. This accounts for the fact that their number exceeds the total number of positive cultures.

TABLE XIV.—PATHOLOGIC REPORTS IN 22 CASES OF PERFORATED GALL BLADDER

Pathology	No. of cases	Percentage
Adenocarcinoma	1	4.5
Gangrene	5	24.0
Acute cholecystitis	3	14.3
Acute exacerbation of chronic cholecystitis	7	33.6
Chronic cholecystitis	6	28.6

TABLE XV.—LENGTH OF HOSPITAL VISIT

Hospital stay—days	No. of cases	Percentage
4	1	4
8 to 10	3	12
14 to 30	12	48
30 to 60	7	28
60 to 90	2	8

Length of hospital stay. Table XV shows that the most frequent hospital stay was between 14 and 30 days. In the series of 20 cases reported by Schaeffer in 1942, the average stay in the hospital of those patients who recovered was 27.4 days.

Mortality. Our total mortality was 24 per cent while the percentage for each of Niemeier's three types is shown in Table XVI. Judd and Phillips (1933) had 6 deaths in 61 cases (9.8 per cent). The total mortality for 433 cases of perforated gall bladder collected from the literature is shown in Table I to average 20.8 per cent. The mortality depends to a large extent on the number of cases with generalized peritonitis. Fifield (1926) analyzed 28 cases of perforation of the gall bladder with 12 deaths (43 per cent mortality), but 15 of the 28 cases demonstrated diffuse peritonitis at the time of operation, with 10 deaths. Thus, Fifield's mortality in the cases with diffuse peritonitis was 67 per cent; while in the localized perforations it was only 15 per cent.

Follow-up. As shown in Table XIX, more than half of our cases were followed more than 3 years. Almost without exception they had no further complaints referable to the gall bladder. One patient developed an incisional hernia and died following repair 3 years after original operation.

COMMENT ON EARLY OR LATE OPERATION

Perforation of the gall bladder is of interest in two respects: (1) because of its own importance, and (2) because of light cast upon the question as to whether or not to operate early in acute cholecystitis. Recently, there has been renewed interest in early operation for acute cholecystitis. Advocates of early operation include: Walton (1923), Miller (1930), Zinninger (1931), Judd and Phillips (1933), Henry Graham (1934), Heuer (1934), Mentzer (1936), Glenn (1938), Hotz (1939), Stone and Owings (1939), Atlee and Atlee (1941), Schaeffer (1942), and Stout and Hibbard (1943). Opponents of early operation include: Smith (1933), Behrend (1934), Pennoyer (1938), Roscoe Graham (1939), Fallis and McClure (1940), and Bonn and Bachhuber (1940). Nix (1940) also opposes early operation in acute cholecystitis. He cited Karullon who reported 6,114 consecutive necropsies with 572 cases of gall stones, only 3 of which had succumbed to perforation, and also

TABLE XVI.—MORTALITY

Mortality	No. of cases	Percentage
Recovery, total cases	19	76
Death, total cases	6	24
Mortality, 6 cases type 1	1	16.6
Mortality, 16 cases type 2	4	20.0
Mortality, 3 cases type 3	1	33.0

McWilliams who reported 3,180 cases of gall-bladder disease with 29 perforations, a percentage of 0.9. Again the questions arise as to how many of McWilliams' cases were acute and in Karullon's study as to how many of the cases represented gall-bladder disease at all. It is obvious that of the 572 instances of gall stones found at necropsy by Karullon, the majority may represent an incidental finding.

Glenn and Moore (1942) summarize their opinions regarding operation in acute cholecystitis as follows:

"In a review of our total experience with this disease we have concluded that we are unable to distinguish acute cholecystitis, acute cholecystitis with gangrene, and perforation which has resulted in a walled-off abscess. Free perforation into the peritoneal cavity of a gangrenous gall bladder is rarely recognized early enough to save the patient's life.

"Acute cholecystitis in patients over 50 at once becomes a more serious disease than acute cholecystitis in patients under 50. If one is to employ surgical therapy for patients under 50, then it should be urged much more forcefully for those over 50, because it is in this group that perforation and free perforation are most likely to occur."

SUMMARY AND CONCLUSIONS

1. A series of 25 consecutive perforations of the gall bladder operated upon at the Henry Ford Hospital during the 22 year period, September, 1921, to April, 1943, is presented. During this same period there were 2,750 gall-bladder operations of all types performed at this hospital. In the literature perforated gall bladder occurs in 2.8 per cent of gall-bladder operations of all types, but in 13.0 per cent of operations on acute chole-

TABLE XVII. — LENGTH OF FOLLOW-UP IN 19 RECOVERED CASES OF PERFORATED GALL BLADDER

Follow-up	No. of cases	Percentage
Less than 3 months	4	21.1
5 to 10 months	2	10.5
18 months	1	5.3
3 to 5 years	5	26.3
6 to 8 years	5	26.3
12 to 17 years	2	10.5

cystitis. Our own figures were a little lower in both instances.

2. Our mortality in the 25 cases was 24 per cent; in 433 cases of perforated gall bladder collected from the literature it was 20.8 per cent.

3. Of our 25 cases, 6 represented an acute free perforation (Niemeier type 1), 16 a localized pericholecystic abscess (Niemeier type 2), and 3 a perforation into a viscus (Niemeier type 3).

4. The accident was most common in females past 50 years of age with a short present illness, but with a long history of attacks of chronic cholecystitis. Pain in the right upper quadrant, with localized tenderness and in 24 per cent of cases a localized mass, along with laboratory evidences of infection or inflammation are helpful in suggesting the diagnosis, but the latter is seldom made before operation.

5. It is difficult to distinguish uncomplicated acute cholecystitis from acute cholecystitis with impending or actual perforation. This difficulty would argue for careful observation of all cases of acute cholecystitis especially in patients over 50 years of age. On the other hand it is impossible to say that our series of cases argues for routine early operation. A review of our 6 deaths indicates that only 2 of these patients might have been saved by earlier operation during the last attack. However, 5 of them might have been saved by operation in a free interval after a previous attack since their symptoms were all of long standing.

6. The lesson to be gained from a study of these cases, therefore, is not so much that immediate operation should be performed in acute cholecystitis, although the need for careful observation and individualization is indicated and in many cases early operation should be done after proper preparation, but that interval cholecystectomy should be more frequently done in recurrent cases of chronic cholecystitis.

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VOLVULUS OF THE SIGMOID COLON

Discussion of Combined Volvulus and Hepatodiaphragmatic Interposition

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THE occurrence of volvulus in this country is relatively infrequent. By contrast, sigmoid volvulus occurring as an acute abdominal emergency is very common in Russia and Germany. Perlmann, reporting from his clinic in Russia, states that over 50 per cent of intestinal obstruction is found to be caused by volvulus. The frequency of redundant colons is attributed by most authors to a coarse vegetable diet rich in undigestible cellulose which makes a great demand on the pelvic colon as a fecal storehouse. Although in most cases an unusually long, mobile mesocolon is recognized as the fundamental basis of volvulus, megasigmoid, with or without megacolon, abnormalities in fecal rotation of the bowel, bands, adhesions, or tumors may also be factors. In 1 of the cases herein reported hepatodiaphragmatic interposition of the colon was present in addition to a volvulus of the megasigmoid, 2 relatively uncommon and usually distinct conditions.

CASE 1. B. M., a 32 year old white male, born in Russia, was admitted to the hospital February 2, 1941. His chief complaint was abdominal pain of 12 hours' duration. The patient was a known diabetic under control without the use of insulin. About 1 month before admission the patient had a transitory attack of grippe, lost weight, and felt under par. On the evening before admission to the hospital, shortly after supper, the patient experienced upper abdominal pain without nausea or vomiting. He had two small bowel movements. The following morning he gave himself an enema with very poor results. On the day of admission he vomited small amounts of undigested food, three times. No blood was observed in the vomitus or stool.

Physical examination revealed a pale, acutely ill male, with temperature, pulse, and respirations normal. The examination was negative except for the abdomen which was distended, soft, with no rigidity or hyperesthesia. Rebound tenderness was absent. Several hours after admission the pain became more severe and seemed to localize in the center of the abdomen. The vomiting became more profuse and consisted of copious amounts of brown, undigested, semiliquid material. Re-examination of the abdomen revealed what appeared to be an obliteration of liver dullness. This had not been noticed on previous examination. When he was rolled from side to side, or when the right upper quadrant was stroked with the hand, a splashing sound could be heard. The abdomen continued to be slightly distended and felt doughy rather than rigid. Roentgenograms were made with the patient in various positions, and, in the absence of the roentgenologist, were interpreted as showing free air under the right dome of the diaphragm resembling a spontaneous pneumoperitoneum due to a perforated hollow intra-abdominal viscus.

In spite of the lack of clinical findings to corroborate the roentgen interpretation, exploratory laparotomy was performed about 9 hours after admission to the hospital. When the peritoneum was opened there was no escape of free air. A moderate amount of free, clear straw colored fluid was present. Further examination showed a large, dilated loop of bowel on the right side of the abdomen. In the delivering of the loop, detorsion occurred and further investigation proved this loop to be an unusually large sigmoid. The bowel was so mobile it could be taken completely out of the abdomen. It resembled an inflated inner tube. The bowel was somewhat injected and contained a great deal of fluid and hard fecal masses. When it was made certain that the obstruction was relieved, the bowel was replaced in the left quadrant and the abdomen was closed.

A review of the films the following morning made possible the recognition of the hepatodiaphragmatic interposition of the colon which complicated the sigmoid volvulus. A film of the abdomen with the patient upright to show the diaphragm (Fig. 1) demonstrated the absence of the liver shadow beneath the right dome of the diaphragm, while on the left, a distended colon containing considerable stool was identified by the broad haustral septa. A film made with the patient in the left lateral recumbent position showed a column of air (Fig. 2) between the liver shadow and the right lateral abdominal wall and diaphragm. This column of air was traversed by a solitary haustral band which immediately identified the air as being colonic and not free in the peritoneal cavity.

The patient's postoperative course was complicated by a few patches of atelectasis which responded to conservative treatment, and he went on to complete recovery.

On June 6, 1941 he was readmitted to the hospital with the interval history that he had been fairly well except for marked constipation. On the afternoon of this admission he was seized with severe cramping epigastric pain of increasing severity which radiated down to the umbilicus. His bowels had not moved for 3 days and he had vomited. He gave himself an oil retention enema which he expelled with some stool and flatus affording considerable relief. Examination on admission to the hospital showed him to be poorly developed and acutely ill. The abdomen again was distended, doughy to palpation, and diffusely tender. There was no rebound pain or muscle guard. Tympany could be elicited over the entire abdomen. Roentgenograms made on this admission showed an appearance identical with the films on the initial admission. Hepatodiaphragmatic interposition of the colon was again demonstrable. The patient was treated conservatively with repeated enemas, and his abdominal pain and vomiting was relieved. A barium enema was given in order to identify

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Fig. 1. Film of abdomen with patient upright illustrating the absence of liver shadow beneath right dome of the diaphragm.

Fig. 2. Patient in left lateral recumbent position showing a column of air beneath the liver, right lateral wall and diaphragm.

and locate the bowel in the right upper quadrant, but at the start of the enema a preliminary survey showed that the interposition had spontaneously reduced itself. The barium enema was given, however, and an unusually long redundant sigmoid flexure was found whose upper extremity lay immediately beneath the under surface of the liver. The remainder of the large bowel was generally dilated (Fig. 3), and as the column of barium progressed to the hepatic flexure the sigmoid loop was displaced downward by the distended transverse and ascending colon segments which lay external to, and above, the sigmoid bend. With the obstruction again relieved, operative measures were recommended to the patient but were refused.

On June 20, 1941 he was readmitted because of repeated attacks of abdominal pain and constipation as on his first and second admissions to the hospital. The patient now consented to operative intervention. Under spinal anesthesia an obstructive resection of the redundant dilated sigmoid loop was performed (Fig. 4). His postoperative course was uncomplicated and several months later he was readmitted for closure of the colostomy opening, with good results.

CASE 2. A. C., a colored male, 26 years of age, a laborer, was admitted to the Homer Phillips Hospital July 19, 1941, with the history of colicky, cramplike, generalized recurrent abdominal pain which began 36 hours before admission. The patient was nauseated and vomited once. Self-medication consisted of vinegar, soda bicarbonate, and epsom salts, which resulted in a very small liquid stool.

Physical examination on admission showed a well developed, and well nourished negro male lying in bed with both knees flexed, holding his abdomen with both hands. The abdomen was symmetrically distended and generally tender to deep palpation. There were no masses or areas of localized tenderness. The act of examination produced generalized colicky abdominal pain. There was no fluid wave or visible peristalsis. There was audible peristalsis at intervals of 3 to 10 minutes. An x-ray examination shortly after admission showed gaseous distention of the small intestine in the upright position with a definite fluid level. There was no free gas.

Operation 24 hours after admission, under spinal anesthesia, showed a moderate amount of blood tinged free fluid in the peritoneal cavity. The sigmoid colon was found to be greatly enlarged, redundant, and extended across the midline and above the umbilicus to the upper right quadrant. The bowel and the adjacent mesentery were found to be twisted upon themselves. The color of the bowel was good. The sigmoid loop was unwound and decompressed by a rectal tube and was replaced in the left colonic gutter. Further exploration of the abdomen revealed nothing of note. Diagnosis: volvulus of megasigmoid.

The postoperative course was complicated by a pulmonary infection, which responded readily to therapy. The patient was out of bed on the 12th postoperative day and was discharged on the 15th postoperative day after refusal to submit to a resection of the redundant sigmoid which he was urgently advised to undergo.

He remained entirely free of symptoms until July 22, 1942, almost 1 year following his initial attack, when he was admitted to the service of Dr. Carl J. Heifetz complaining of cramping abdominal pain of 24 hours' duration. He complained of a desire to defecate but was unable to do so. The last normal bowel movement had been 2 days before admission. The patient had been nauseated and vomited once on the way to the hospital. The abdominal

Fig. 3. Showing the generally dilated large bowel with the displaced sigmoid loop.

Fig. 4. Specimen after removal.

pains radiated up the left half of the abdomen and across the upper abdomen, and were so severe as to cause the patient to cry out with each attack.

Physical examination showed a young adult male negro tossing in bed and complaining of severe pain in the abdomen. The abdomen was moderately distended, and it was possible to observe peristaltic contractions traversing the lower abdomen. On palpation the abdomen was fairly rigid but showed no localized areas of tenderness. There was only slight rebound tenderness. There was a tympanitic note over the entire abdomen with diminution in the region of liver dullness.

The patient was operated upon 8 hours after admission, under spinal anesthesia. When the abdomen was opened no free fluid was found. The sigmoid was markedly distended and twisted on itself in a counterclockwise manner with the obstruction at the site of torsion of the bowel. The bowel obstruction was relieved by twisting the bowel in a clockwise manner. A Mikulicz resection of the distended sigmoid was then accomplished, the redundant portion of the bowel being excised. The patient had a normal postoperative course and subsequently closure of the colostomy was accomplished, with good results.

Hepatodiaphragmatic interposition of the colon refers to that condition in which a portion of the colon is to be found located between the dome of the liver and the right leaf of the diaphragm. Since varying degrees of displacement of the liver downward and medially usually occurs, therefore, the term hepatoptosis has been used in this connection.

The roentgenologic findings in this condition were first described by Béclère in 1899, who wrongly interpreted the findings as those of a subphrenic abscess. Subsequent postmortem studies showed the true nature of the case. Chilaiditi, in 1910, made the first extensive contribution to the literature on this subject and subsequent authors have referred to hepatodiaphragmatic interposition of the colon as the "Chilaiditi syndrome."

Interposition of the colon is most frequently found during routine fluoroscopic or radiographic examinations of the chest or abdomen. Kolju reports 29 cases which were discovered incidental to routine methods of examination, and it is very infrequent that symptoms can be traced to this condition or that surgical procedures are necessary. He concludes that the causative factors are (1) alteration of intra-abdominal pressure, (2) alteration of the statics and dynamics of the diaphragm associated with disease conditions of the organs in the chest, and (3) defects of the supportive apparatus of the liver.

Hepatodiaphragmatic interposition of the colon is of greatest importance in the necessity for differentiation of this condition from other more

serious surgical emergencies. Chief among these is spontaneous pneumoperitoneum due to perforation of a hollow viscus, and right sided subphrenic abscess. The difficulties which can be encountered in this connection are illustrated by the reports of Pendergrass and Kirk. They reported a case of hepatic interposition of the colon which was mistaken for free air in the peritoneal cavity. At operation, there were no signs of a perforated viscus, but rather an acute pancreatitis was found. Schenck reported a case of a 45 year old negress who had both a spontaneous pneumoperitoneum due to a perforated prepyloric ulcer and hepatic interposition of the colon. A distinct fluid level was present on the films made with the patient in the erect position, while those made in the recumbent position showed the haustral septa of the gas-filled distended colon.

Volvulus may occur in the sigmoid-cecum and in the small intestine. The most common site is the sigmoid.

The symptoms of volvulus simulate closely the findings of other obstructive lesions of the colon or small intestine depending on the acuteness or chronicity.

Volvulus of the sigmoid shows a decided tendency to recur. Bloodgood reports a case in which there were 32 attacks or recurrences in one individual in a space of 16 years.

Untwisting the bowel in a case of volvulus accomplishes nothing toward removing the predisposing or etiological factors. Statistics appear to indicate that once volvulus takes place recurrence is more likely to occur than before. A simple untwisting and replacement of the bowel into its normal abdominal position appears to be insufficient. Since shortening of the mesentery, sigmoidopexy, and other procedures have not produced satisfactory results, it is our opinion that an immediate obstructive resection should be attempted at the primary exploration if it is possible. This will obviate a subsequent operation.

SUMMARY

Two cases of recurrent volvulus of a sigmoid megacolon, one with hepatodiaphragmatic interposition of the sigmoid colon, are reported. The presence of an unusually long mobile sigmoid is the basic factor for the simultaneous occurrence of 2 relatively uncommon and usually distinct pathological conditions, namely, volvulus and hepatodiaphragmatic interposition.

Immediate resection of the sigmoid should be performed for volvulus when it is at all feasible.

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EDITORIALS

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TOTAL HYSTERECTOMY

COMPLETE hysterectomy is being performed with increasing frequency in the treatment of lesions involving the uterus, whether the process be benign or malignant. Some surgeons always perform the total variety of hysterectomy. It is the belief of some surgeons that every patient possessing a diseased cervix in association with other uterine conditions, even though no malignant process is present, should have a total hysterectomy. Many arguments in favor of such a routine procedure have been advanced; some have been raised in opposition.

Obviously, the chief advantage of the total operation is that the cervix, the possible site of infection or neoplasm, is removed. Probably that is the sole point in its favor. The question arises whether the advantage of eliminating the cervix outweighs the disadvantages of increased mortality and morbidity.

The incidence of stump cancer is variously stated. Von Graff places it at 0.62 per cent among 7,244 subtotal hysterectomies. While there is great difficulty in determining the exact incidence yet it is fair to assume that cancer has already been present if it appears in the cervix in the first year after a subtotal hysterectomy. Ward, in a report covering the twenty year period prior to 1940, gives the incidence of stump cancer occurring at the Women's Hospital in New York as 6.9 per cent. His findings, as well as those of others who have recently written on the subject, strongly suggest that the condition occurs more frequently than we had first thought.

Since Spencer, in 1902, first called our attention to the frequent coincidence of malignant tumors involving the cervix with fibroids involving the corpus, innumerable references to the matter have been made and provide additional arguments for the proponents of total hysterectomy.

As Martzloff recently pointed out in this Journal, "the major issue seems to be whether, when abdominal hysterectomy is performed for benign disease, total hysterectomy should be employed as an inflexible routine in order to forestall the possibility of future malignant change which, presumably, exists as long as there is the slightest cervical residuum."

All writers agree that total hysterectomy may be accompanied by a higher incidence of postoperative hemorrhage, shock, damage to the bladder, ureters, and rectum, cystitis, pelvic cellulitis, wound infection, phlebitis, and thrombitis. Nearly all, however, conclude that such complications are no more common with the total operation than with supracervical hysterectomy provided the operation is *expertly performed.*

Nearly all surgeons accept the proposition that neither the total nor the subtotal opera-

tion should be recommended as a routine procedure; also nearly all agree that the total operation would be preferred were it not that it takes longer to perform, that it requires greater skill, and that, as revealed from accumulated figures from unselected clinics, it is accompanied by higher mortality.

Many experienced surgeons disagree with those who contend that the cervix can be adequately treated, either before or after a subtotal hysterectomy, by such procedures as trachelorrhaphy, cauterization, or low amputation. Von Graff has reported 37 cases of cancer developing in cervical stumps following partial hysterectomy, even after the cervix had been cauterized, or coned, at the time of the hysterectomy.

If total hysterectomy were performed routinely by all surgeons, by those of great skill as well as by those of limited experience, mortality undoubtedly would be high. The surgeon who performs six or eight hysterectomies a year should confine himself to the supracervical procedure, yet the surgeon who performs, annually, a hundred or more should be able to carry out the total operation expertly and with a mortality no greater than that of any surgeon who adheres to the less formidable procedure. It is probably true that, if all hysterectomics were of the complete type, the ultimate mortality would be greater than it is at present with supravaginal hysterectomy, plus those cancer deaths resulting from neoplastic disease developing in the retained cervix.

We agree with the many writers who have studied the questions and who state that it does not necessarily mean that "total abdominal hysterectomy is a dangerous and radical operation when performed by one experienced and proficient in pelvic surgery." It is not an operation for the occasional operator. It is an operation for a thoroughly trained and experienced surgeon. With him it is a safe procedure, and with the majority of patients requiring a hysterectomy total hysterectomy is the best procedure.

While the value of total hysterectomy in the prevention of cervical cancer is accepted, the presence of benign disease plus the *possibility* of subsequent cancerous change, is not an incontestable indication for panhysterectomy if the procedure is to be accompanied by increased operative risk and result in higher mortality than would follow if the hysterectomy were of the supracervical type. The question of which procedure to elect resolves itself therefore largely into a matter of degree of surgical experience and technical skill.

HAROLD L. FOSS

ACUTE CHOLECYSTITIS—WHY OPINIONS DIFFER AS TO TREATMENT

MOST of the present confusion in the care of acute cholecystitis has arisen from the difficulty in defining what is meant by "acute cholecystitis" and by "early operation." Acute cholecystitis has been used by some authors to denote an acute attack of pain in the gall-bladder region or pain plus other clinical and laboratory findings or merely a pathological picture seen in microscopic sections. "Early operation" to some surgeons means early in the course of the disease while most writers mean a prompt intervention after the patient has entered the hospital, which may be seven or eight days after the onset.

To the clinician an agreement on a few definitions would aid greatly in the care of these cases. Let us assume that an "early operation" is one performed within 48 hours of the onset of the acute symptoms; that a "moderately early operation" is one undertaken

only after the clinical signs and symptoms have subsided.

From a practical standpoint, it would be better to substitute the term "acute gall bladder attack" for "acute cholecystitis." This would include gall-stone colic, edema of the gall bladder, and true, well established, "acute cholecystitis."

A clear picture of the usual sequence of pathological events in these conditions is of great value in a study of their treatment. Clute's description appeals very strongly to me. He believes that acute gall-bladder disease usually is not caused by infection, but that it often starts with the impaction of a stone in the entrance to the cystic duct, that edema occurs from pressure and that branches of the cystic artery are occluded with localized or general gangrene in about 20 per cent of the hospital cases. . . . Perforation is not uncommon. Some authors place perforation at over 10 per cent in the acute cases when patients come to operation late in the disease. Infection is seldom an important factor within 48 hours of the onset. The outcome in an individual patient, while under observation, cannot be accurately predicted nor can the exact pathological condition present in the gall bladder be determined by the surgeon before operation. Touroff, Eliason, Judd, Roscoe Graham, Fallis and McClure, Pennoyer, Heuer, Glenn, and many others confirm this statement. In more than one-half the cases, the disease is a progressive and not a regressive one. Delay leads to serious irreversible changes and increased mortality. When operation is performed within 48 hours of the onset infection is negligible; death will seldom follow unless perforation or pancreatitis is already present or the patient has had many previous attacks or is old and feeble. Delay will not save the patient with the fulminating type of disease, nor will it help the aged or the patient with diseased organs. In the early cases adequate preparation can usually be made within a few hours after the patient enters the hospital. The operation if done within 48 hours is not a dangerous one; usually it is best to remove the gall bladder from above downward. Some modification of the usual total cholecystectomy may be preferable in some cases as recommended by Heyd, but, in spite of Cutler and Zollinger's splendid mortality figures, I agree with Heyd that a cholecystostomy should seldom be performed. Cholecystectomy removes the disease and the postoperative course is smooth; complications are few and the time in the hospital is short. The mortality should be under 4 per cent. I cite Pratt; Heuer, Glenn, Finsterer; the Post Graduate Hospital series, excluding those cases in which acute pancreatitis was already present at operation, and the series of 167 early cases collected by Graham and Hoefle. Patients in the group of moderately early cases, those seen within five days, do well with a little preparation but operations performed a week or more after the onset have a high mortality, hence, each such patient must be individually studied. They have suffered from pain, loss of sleep, and lack of food. They may be anemic and dehydrated, and other organic disease may have been aggravated. Careful preparation must be made with fluids, narcotics, transfusions, food, if possible, and all other necessary measures should be taken. Then the decision must be made whether to operate or delay. No rule can be laid down as to the proper time for operation in these late cases.

How do these opinions agree with those found in our surgical journals? Touroff analyzed 75 proved cases of acute cholecystitis in which patients were treated by delayed operation; in 42 per cent operation revealed the presence of pus, gangrene, or perforation.

What is meant by "acute cholecystitis"? Let me attempt to show how difficult it is to answer this question. Pennoyer reviewed the Roosevelt Hospital cases using a clinical yardstick consisting of pain, temperature of 101 degrees, a leucocytosis of 12,000 or over, muscle spasm, and tenderness. Cases of gall-stone colic without fever or leucocytosis were excluded, and he frankly states that several cases with an old rupture and localized abscess were not included because they had no fever, no leucocytosis, and no acute symptoms except perhaps tenderness and muscle spasm. Personally, I feel that one individual may run the whole gamut of variations starting with gall-stone colic and ending with gangrene and perforation as the disease progresses.

Cave says, "It is observed that immediate operation in our hands gave a mortality rate of 20 per cent." It is evident from his paper that immediate operation was practiced only on the critically ill whose condition was not improving. Delay seemed dangerous so operation could not be avoided. Naturally the mortality would be high in this selected bad risk group. Speaking of the delayed operation he adds: "It is striking to note the smooth convalescence of patients operated upon when gangrene, perforation, and localized abscess have ensued." What a humiliating thought it is that gangrene, perforation, and abscess should be present at operation in any gall-bladder case. This is no criticism of the authors of these papers for they are scholarly, well written, and honest presentations of the material analyzed.

Fallis and McClure had similar difficulties. They studied only those cases on which a pathological diagnosis of acute cholecystitis had been made and concluded that the best results were obtained by deferring operation until 72 hours had elapsed. They state, however, "This excluded from our review many cases in which a diagnosis of acute cholecystitis had been made by both the clinician and the operating surgeon. . . . If these cases of simple edema of the gall bladder which accompanies gall-stone colic had been included, our results would have been materially affected, and a brief for, rather than against, immediate operation would have been presented."

Is it not evident that this simple edema of the gall bladder that they mentioned is often an early stage of acute cholecystitis and that operation in this stage is safer and better than one when real pathological evidence of polynuclear infiltration of the gall bladder is present?

Roscoe Graham introduces the term "urgent operation" and argues against it. He states that the average length of time from onset to admission to their hospital was six days. He makes this significant statement: "That one can submit to operation within the first 48 hours a very large percentage of patients suffering from severe and persistent biliary colic, with a very low operative mortality, is not surprising." He also says, "Persistent biliary colic produces an acute cholecystitis." Would it not be better if patients with acute gall-bladder disease could be persuaded to enter the hospital much sooner than six days on an average and then have a prompt operation?

The time will come when an educated profession and an educated public will demand a prompt operation early in these acute gall-bladder attacks. HENRY F. GRAHAM.

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

EVERY urologist, veteran or neophyte, will wish to read carefully and keep *Transurethral Prostatectomy*[1] by Reed M. Nesbit in his library for continued reference. It ably illustrates the modern advances which have been achieved in the development of a transurethral method for relieving prostatic obstruction. This method has been the subject of monographic reports on several occasions since Guthrie published his work in 1834. From a wealth of personal experience Nesbit has been able to outline in detail the methods which have given him satisfactory and permanent results. The modern instruments adapted to this procedure have, in the main, been perfected by American urologists and manufacturers. Nesbit has developed a modification of the Stern-McCarthy instrument and, while his technique is largely based on the application of his own method of removing tissue, his ideas and suggestions can be wisely utilized by any surgeon familiar with transurethral prostatic resection while using any other suitable type of instrument. This book is prefaced by a chapter on the arterial distribution within the prostate gland and its significance in transurethral resection. A careful study of this chapter by Rubin H. Flocks will be most instructive for anyone who is hopeful of becoming proficient in this branch of surgery. Armamentarium, the use of the resectoscope, diagnosis and selection of patients for operation, suitable anesthesia, and the technique of actual tissue removal are discussed in detail. The illustrations of William P. Didusch represent the application of a knowledge and skill in urological drawing acquired during a quarter of a century. They add greatly to the value of the text.

In the discussion on preoperative management the subject of "water balance," so important in the proper care of patients with prostatic obstruction, is covered in a noteworthy manner. Since much of the investigative and clinical data on this subject originated at the University of Michigan Hospital the conclusions are most authoritative.

Modern developments in the management of prostatic malignant tumors by orchiectomy or estrogen therapy are reviewed in a manner which is both clear and concise.

Nesbit's final evaluation as to the efficacy of transurethral prostatectomy sums up to a most satisfactory personal experience, with low mortality and morbidity, and a high percentage of excellent urinary function on the part of the great majority of his patients.

VINCENT J. O'CONOR.

[1] TRANSURETHRAL PROSTATECTOMY. By Reed M. Nesbit, M.D., F.A.C.S. Springfield, Illinois: Charles C. Thomas, 1943.

THE second edition of *Outline of Roentgen Diagnosis*[2] by Dr. L. G. Rigler has been brought up to date and includes all of the latest changes. Some of the subject matter has been rearranged. The first edition has proved an excellent textbook for medical students. It is concise and well arranged. The new edition should prove even more useful. The only criticism is regarding the illustrations which have not been changed; they are too small and the reproductions are not too good.

R. G. WILLY.

A MOST interesting account of the contributions of the medical department of the United States Army to medical progress has been written by Colonel Hume[3]. This book will be of interest to the layman as well as members of the medical profession. It should be of especial interest to doctors now on duty with our armed forces.

All America is familiar with the work of Major Walter Reed in the study of yellow fever, of Major William Crawford Gorgas and his sanitation of the Panama Canal Zone. Known to medical students is the work of Surgeon William Beaumont in his study of the digestive processes of the stomach through the permanent gastric fistula of the half-breed Alexis St. Martin. Little known interesting facts regarding American medicine add to the interest of this book. The first American textbook on surgery bearing the interesting title *Plain Concise Practical Remarks on the Treatment of Wounds and Fractures; To which is added a Short Appendix, on Camp and Military Hospitals; Principally designed for the use of Young Military and Naval Surgeons in North America*, was written by the American military surgeon, John Jones, and printed in 1776. The history of the establishment of the Army Medical Library and its *Catalogue* is most interesting, considered by Dr. William Henry Welch as America's greatest contribution to medicine. Few of us realize that this is the world's greatest collection of medical books and associated with the library is the Army Medical Museum, the world's largest. Colonel John Shaw Billings was not only the originator of the *Index Catalogue of The Library of the Surgeon General's Office of the United States Army*, and probably the greatest medical officer our Army has ever had, but he also originated the *Index Medicus*, later consoli-

[2] OUTLINE OF ROENTGEN DIAGNOSIS; AN ORIENTATION IN THE BASIC PRINCIPLES OF DIAGNOSIS BY THE ROENTGEN METHOD. By Leo G. Rigler, B.S., M.B., M.D. 2d ed. Philadelphia, London, Montreal: J. B. Lippincott Co., 1943.

[3] VICTORIES OF ARMY MEDICINE; SCIENTIFIC ACCOMPLISHMENTS OF THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY. By Edgar Erskine Hume, Colonel, Medical Corps United States Army. Philadelphia: J. B. Lippincott Co. ,1943.

dated with the *Quarterly Cumulative Index* to be known as the *Quarterly Cumulative Index Medicus*. Billings designed Johns Hopkins and Peter Bent Brigham Hospitals and others, and made many other contributions to American medicine.

Surgeon General George Miller Sternberg was one of America's foremost scientists. Among his many accomplishments he established the Army Medical School and discovered the micro-organism of pneumonia. And so this book unfolds the accomplishments of the medical department of the United States Army—one department at least that was prepared at Pearl Harbor on December 7, 1941 when the Japs attacked.

The author, Colonel Edgar Erskine Hume, writes in a smooth interesting style. He is well qualified to write such a chronicle. He was in charge of the Second Commission to study typhus fever in Serbia. He has written several scientific papers and was Librarian of the Army Medical Library from 1932 to 1936.

EARL O. LATIMER.

THE second edition of the excellent book *A Manual of Otology, Rhinology and Laryngology*[1] by Ballenger contains many changes and additions which bring it up to the present day knowledge. Among the new additions is a chapter covering foreign bodies in the air and food passages. Here also is a detailed description of the surgical technique of tracheotomy which is as a rule an emergency measure so should be known to every practitioner. Dr. John J. Ballenger has rewritten the chapter on paralysis and neurosis of the larynx. This revision has been so well done that it deserves special commendation.

Unlike many other books on this subject, the author stresses the anatomy, etiology, pathology, diagnosis, symptoms, and treatment both general and local. The prognosis is discussed briefly and only in those conditions which are thought to be necessary. Descriptions and discussions of the various surgical techniques are purposely omitted from the text.

This compact book is well written and fully illustrated describing briefly all diseases of the ear, nose, and throat and in sufficient detail to give a clear conception of the subject. The specialist, the practitioner, and the student as well will find the book a most valuable source of information.

L. F. MCBRIDE.

[1] A MANUAL OF OTOLOGY, RHINOLOGY AND LARYNGOLOGY. By Howard C. Ballenger, M.D., F.A.C.S. 2d ed. Philadelphia: Lea & Febiger, 1943

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE EAR, NOSE AND THROAT IN THE SERVICES. By R. Scott Stevenson, M.D., F.R.C.S. (Ed.) Major, R.A.M.C. Oxford War Manuals. Edited by The Rt. Hon. Lord Horder, G.C.V.O. London: Oxford University Press (Humphrey Milford), 1943.

LINCOLN-DOUGLAS; THE WEATHER AS DESTINY. By William F. Petersen. Springfield, Ill., and Baltimore, Md.: Charles C. Thomas, 1943.

FRACTURES AND DISLOCATIONS FOR PRACTITIONERS. By Edwin O. Geckeler, M.D. 3d ed. Baltimore: The Williams & Wilkins Co., 1943.

TEXTBOOK OF SURGICAL TREATMENT; INCLUDING OPERATIVE SURGERY. Edited by C. F. W. Illingworth, M.D., Ch.M., F.R.C.S.E. Baltimore: The Williams & Wilkins Co., 1943.

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